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TRANSACTIONS

OF THE

COLLEGE OF PHYSICIANS

OF

PHILADELPHIA

THIRD SERIES

VOLUME THE FIFTY-FIRST

PHILADELPHIA
PRINTED FOR THE COLLEGE
1929

NOTICE

The present volume of TRANSACTIONS contains the papers read before the College from January, 1929, to December, 1929, inclusive.

The Committee of Publication thinks it proper to say that the College holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its TRANSACTIONS.

EDITED BY

WALTER G. ELMER, M.D.

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DORNAN, PRINTER

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LIST

OF THE

PRESIDENTS OF THE COLLEGE FROM THE TIME OF ITS INSTITUTION

ELECTED	
1787	JOHN REDMAN
1805	WILLIAM SHIPPEN
1809	ADAM KUHN
1818	THOMAS PARKE
1835	THOMAS C. JAMES*
1835	THOMAS T. HEWSON
1848	GEORGE B. WOOD
1879	W. S. W. RUSCHENBERGER
1883	ALFRED STILLÉ
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1884	J. M. DA COSTA
1886	S. WEIR MITCHELL
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1892	S. WEIR MITCHELL
1895	J. M. DA COSTA
1898	JOHN ASHHURST, JR.
1900	W. W. KEEN
1902	HORATIO C. WOOD
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1929

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FELLOWS

OF THE

COLLEGE OF PHYSICIANS OF PHILADELPHIA

DECEMBER, 1929

* Non-resident Fellows. † Fellows who have commuted dues. ‡ Deceased.

ELECTED

1892. Abbott, Alexander Crever, M.D., Sc.D., Dr. P.H., Professor of Hygiene and Bacteriology and Director of the School of Hygiene and Public Health, University of Pennsylvania. 4016 Pine St.

1912. Addison, William H. F., A.B., M.D., Professor of Normal Histology and Embryology in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1926. Adler, Francis Heed, M.A., M.D., Assistant Surgeon, Wills Eye Hospital; Instructor in Ophthalmology and Physiology, University of Pennsylvania. 313 S. Seventeenth St.

1905. Adler, Lewis H., Jr., M.D., Formerly Professor of Proctology in the Graduate School of Medicine, University of Pennsylvania; formerly Prosector to the Professor of Anatomy in the University of Pennsylvania; Consulting Surgeon to the Charity Hospital. 313 S. Seventeenth St.

1914. Aiken, Thomas Gerald, M.D., Physician-in-Chief to the Chester County Hospital, West Chester, Pa.; Pathologist to the Country Branch of the Rush Hospital for Tuberculosis. Berwyn, Pa.

1913. Alexander, Emory G., M.D., Assistant Professor of Surgery, Medical School, University of Pennsylvania; Surgeon to the Episcopal, St. Christopher's Hospital for Children and Abington Hospitals. 337 S. Eighteenth St.

1906. Allen, Francis Olcott, Jr., A.B., M.D. 2216 Walnut St.

1896. Allyn, Herman B., A.B., M.D., Consulting Physician to the Philadelphia General Hospital. 3910 Chestnut St.

1888. Anders, James M., M.D., LL.D., Professor of Medicine in the Graduate School of Medicine, University of Pennsylvania; Officer de l'Instruction Publique. 250 S. Seventeenth St.

ELECTED

1905. Anspach, Brooke M., M.D., Professor of Gynecology in the Jefferson Medical College; Attending Gynecologist, Jefferson Hospital; Attending Gynecologist to the Bryn Mawr Hospital. 1827 Spruce St.

1905. Appleman, Leighton F., M.D., Attending Surgeon to the Wills Eye Hospital; Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Ophthalmologist to the Frederick Douglass Memorial Hospital and to the Burd School; Demonstrator of Pharmacy and Materia Medica, and Instructor in Therapeutics in the Jefferson Medical College. 308 S. Sixteenth St.

1922. Arnett, John Hancock, A.B., M.D., Physician to the Episcopal Hospital; Instructor in Medicine, Medical School, University of Pennsylvania. 2116 Pine St.

1906. Ashhurst, Astley Paston Cooper, A.B., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the Episcopal Hospital and to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. 257 S. Sixteenth St.

1893. Ashton, Thomas G., M.D. Wynnewood, Pa.

1920. Astley, George Mason, M.D., Assistant Surgeon, Samaritan Hospital. 5317 Master St.

1914. Austin, J. Harold, B.S. (Univ. of Penna.), M.D., Professor of Research Medicine, University of Pennsylvania. John Herr Musser Department of Research Medicine, University of Pennslyvania.

1906. Babbitt, James A., A.B. (Yale), A.M. (Haverford), M.D., Assistant Professor of Otolaryngology, University of Pennsylvania; Associate Professor of Otolaryngology, Graduate School of Medicine, University of Pennsylvania; Assistant Laryngologist and Aurist, Lankenau Hospital; Laryngologist, Mary Drexel Children's Hospital. 1912 Spruce St.

1910. Baer, Benjamin F., Jr., B.S., M.D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Assistant Ophthalmologist, University Hospital; Attending Surgeon to Wills Eye Hospital; Ophthalmologist, Howard Hospital. 1927 Spruce St.

‡1892. Baker, George Fales, B.S., M.D. 1818 Spruce St.

1911. Baldwin, James Harvey, A.B., M.D., Surgeon to the Methodist Hospital. 1426 Pine St.

ELECTED

1916. Balentine, Percival L., M.D., Assistant Surgeon, Wills Eye Hospital. 302 Weightman Building, 1524 Chestnut St.

1898. Balliet, Tilghman M., A.M., M.D., Professor of Therapeutics at Dartmouth College, Hanover, N. H.; Physician to the Old Man's Home. 3920 Sansom St.

1911. Barnard, Everett P., M.D., Obstetrician to the Maternity Hospital; Assistant Instructor in Obstetrics in the University of Pennsylvania. 1820 S. Rittenhouse Square.

1924. Bartle, Henry J., B. S., M.D., Clinical Assistant, Department for Disease of the Stomach and Bowels, Jefferson Medical College and Hospital. 1930 Chestnut St.

1921. Bauer, Edward L., M.D., Professor of Children's Diseases, Jefferson Medical College; Pediatrist to the Jefferson and Memorial Hospitals and the Philadelphia Hospital for Contagious Diseases; Consulting Pediatrist, Germantown Hospital. 345 S. Nineteenth St.

1883. Baum, Charles, A.M., M.D., Ph.D. 1828 Wallace St.

1922. Bazett, Henry Cuthbert, M.A., M.D. (Oxon.), F.R.C.S. (England), Professor of Physiology, University of Pennsylvania. Bryn Mawr, Pa.

1908. Beardsley, Edward J. G., M.D., L.R.C.P. (Lond.), Clinical Professor of Medicine in the Jefferson Medical College; Chief Clinical Assistant in the Out-Patient Medical Department of the Jefferson Medical College Hospital; Assistant Physician to the Jefferson Hospital. 1919 Spruce St.

*1916. Bell, William Hemphill, M.D., Captain, Medical Corps, U. S. Navy; Commanding Officer, U. S. Naval Hospital, Newport, R. I.

1923. Bergey, David H., A.M., M.D., B.S., Dr. P.H., Professor of Hygiene and Bacteriology, University of Pennsylvania. 206 S. Fifty-third St.

*1903. Biggs, Montgomery H., M.D., Surgeon to the Rutherford Hospital; Chief Surgeon of the Carolina, Churchfield and Ohio Railway. Rutherfordton, N. C.

1918. Billings, Arthur E., M.D., Assistant Professor of Surgery, Jefferson Medical College; Assistant Surgeon, Jefferson Hospital; Surgeon to Pennsylvania and Bryn Mawr Hospitals. 2020 Spruce St.

1917. Birdsall, Joseph C., A.B., A.M., M.D., Associate Professor of Urology in the Graduate School of Medicine, and Urologist to the Hospital of the Graduate School of Medicine, University of Pennsylvania; Assistant in Genito-urinary Dispensary, Presbyterian Hospital. 4610 Spruce St.

ELECTED

1908. Bland, Pascal Brooke, M.D., Professor of Obstetrics, Jefferson Medical College; Visiting Obstetrician, Jefferson Medical College; Gynecologist to St. Joseph's Hospital. 1621 Spruce Street.

1917. Block, Frank B., A.B., M.D., Surgeon to the Jewish Hospital; Associate in Gynecology in the University of Pennsylvania. Medical Arts Building.

1894. Bochroch, Max H., M.D., Professor of Nervous and Mental Diseases, Temple University; Visiting Physician to the Psychopathic Wards of the Philadelphia General Hospital. 1539 Pine St.

1929. Bockus, Harry L., B.S., M.D., Associate Professor of Gastroenterology, Graduate School of Medicine, University of Pennsylvania, and Attending Gastroenterologist, Graduate Hospital; Attending Physician, Presbyterian Hospital. 250 S. Eighteenth St.

1896. Boger, John A., A.M., M.D., Surgeon to St. Mary's Hospital; Surgeon to the Stetson Hospital. 2213 N. Broad St.

1928. Boles, Russell S., M.D., Associate in Medicine, University of Pennsylvania; Visiting Physician, Philadelphia General Hospital; Consulting Gastroenterologist, U. S. Veterans' Bureau, Philadelphia. Rittenhouse Plaza.

1923. Bond Earl, D., A.B., M.D., Physician-in-Chief, Pennsylvania Hospital, Department for Mental and Nervous Diseases; Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. Bryn Mawr, Pa.

1911. Bonney, Charles W., A.B., M.D., Associate in Topographic and Applied Anatomy in the Jefferson Medical College. 1117 Spruce St.

1924. Boon, David J., M.D., Opthalmologist, Memorial Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Ophthalmic Surgeon, Episcopal Hospital. 1532 N. Fifteenth Street.

1921. Borzell, Francis Frank, M.D., Roentgenologist, Frankford Hospital; Chief Clinical Assistant, Roentgen Department, Jefferson Medical College; *X*-Ray Consultant, State Hospital for the Insane, Norristown, Pa. 4910 Frankford Ave.

1913. Boston, L. Napoleon, A.M., M.D., Professor of Physical Diagnosis, Graduate School of Medicine, University of Pennsylvania; Professor of Principles and Practice of Medicine and Clinical Medicine, Woman's Medical College; Physician to the Philadelphia General and College Hospitals. 1737 Chestnut St.

ELECTED

1928. Bothe, Albert Edward, B.S., M.D., M.S., Instructor in Surgery, Medical School and Instructor in Urology, Graduate School, University of Pennsylvania; Assistant in Urology, Presbyterian Hospital; Urologist, Misericordia Hospital. 133 S. Thirty-sixth St.

1928. Bothe, Frederick A., M.S., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, Presbyterian Hospital; Associate Surgeon, Children's Hospital. 133 S. Thirty-sixth St.

1919. Bowen, David Ralph, M.D., Radiologist to the Pennsylvania Hospital. 82 W. Lacrosse Ave., Lansdowne, Pa.

1923. Bower, John O., M.D., Surgeon to the Philadelphia General and United States Veterans' Hospitals; Clinical Professor of Surgical Research, Temple University. 2008 Walnut St.

1891. Boyd, George, M., M.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Consulting Obstetrician to the Preston Retreat and Philadelphia General Hospital. 1909 Spruce St.

1907. Boyer, Henry Percival, M.D., Neurologist to the Stetson Hospital; Physician to the Philadelphia Home for Incurables; Medical Electrician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 4602 Baltimore Ave.

1925. Boykin, Irvine M., M.D., Associate Surgeon to the Episcopal Hospital; Associate in Surgery, Graduate School of Medicine, Instructor in Surgery, School of Medicine, University of Pennsylvania. 922 Medical Arts Building.

1929. Bradbury, Samuel, M.D., Medical Director, Out-Patient Department, Pennsylvania Hospital. 151 W. Coulter St.

1907. Bradley, William N., Ph.G., M.D., Visiting Pediatrist to Howard Hospital; Visiting Pediatrist to Philadelphia General Hospital; Associate in Pediatrics, School of Medicine, University of Pennsylvania; Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania. 1725 Pine St.

1921. Bransfield, John W., M.D., Clinical Professor of Surgery, Woman's Medical College; Visiting Surgeon to St. Agnes, St. Vincent's and Woman's College Hospitals. 2025 Walnut Street.

1903. Branson, Thomas F., M.D., Attending Physician to the Bryn Mawr Hospital. Rosemont, Pa.

‡1891. Brinton, Lewis, M.D., Physician-in-Chief to the American Hospital for Diseases of the Stomach. 1301 Medical Arts Building., Sixteenth and Walnut Sts.

ELECTED

1900. Brinton, Ward, A.M., M.D., Chief of Division of Tuberculosis, Department of Public Health of Philadelphia; Clinical Professor of Medicine, Woman's Medical College of Pennsylvania; Visiting Physician, Department for Tuberculosis, Philadelphia General Hospital, and Eaglesmere Sanatorium. 1423 Spruce St.

1917. Bromer, Ralph S., A.B. (Yale), M.D., Associate in Radiology, Graduate School of Medicine, and Instructor in Roentgenology, School of Medicine, University of Pennslyvania; Roentgenologist to the Episcopal, the Orthopedic and the Children's Hospitals. 504 W. Mt. Airy Ave.

1919. Brown, Henry P. Jr., M.D., Surgeon and Chief of Out-Patient Clinic of the Pennsylvania Hospital; Surgeon to the Children's Hospital; Associate Surgeon, Presbyterian Hospital; Instructor in Surgery in the School of Medicine, and Assistant Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 624 Medical Arts Building.

1916. Brown, Samuel Horton, M.D. 1930 Chestnut St.

1887. Brubaker, Albert P., A.M., M.D., Emeritus Professor of Physiology and Medical Jurisprudence in the Jefferson Medical College. 3426 Powelton Ave.

1916. Buckley, Albert Coulson, M.D., Medical Superintendent, Friends' Hospital, Frankford; Associate Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. Frankford, Phila.

1928. Burden, Verne G., M.D., M.S., Surgeon to St. Joseph's and Philadelphia General Hospitals; Instructor in Surgery, Graduate School of Medicine, University of Pennsylvania. 1912 Pine St.

1927. Burns, Michael A., M.D., Assistant Professor Nervous and Mental Diseases, Jefferson Medical College; Chief of the Nervous and Mental Clinic, Jefferson Hospital; Visiting Neurologist, Philadelphia General Hospital; Neuropsychiatrist, St. Mary's Hospital. N. E. Cor. Twentieth and Chestnut Sts.

1906. Burns, Stillwell C., M.D., Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 1925 Spring Garden St.

1892. Burr, Charles W., M.D., Professor of Mental Diseases in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital. 1918 Spruce St.

1906. Butler, Ralph, M.D., Professor of Laryngology in the Graduate School of Medicine, University of Pennsylvania; Laryngologist and Aurist to the Lankenau Hospital. 1930 Chestnut Street.

ELECTED

*1908. Cadbury, William W., A.M., M.D., Lingnan University, Canton, China.

†1907. Cadwalader, Williams B., M.D., Clinical Professor of Neurology, School of Medicine, University of Pennsylvania; Neurologist to the Presbyterian Hospital; Consulting Neurologist to the Bryn Mawr Hospital. 133 S. Thirty-sixth St.

1928. Campbell, Edward H., M.D., Assistant Otolaryngologist, Pennsylvania and Children's Hospitals, and in Out-Patient Department of Lankenau Hospital; Instructor in Otolaryngology in the Medical School and Graduate School of Medicine, University of Pennsylvania. 2117 Chestnut St.

1905. Carmany, Harry S., M.D., Surgeon to Memorial Hospital, Roxborough; Associate Surgeon of the Episcopal Hospital. 366 Green Lane, Roxborough.

1910. Carnett, John Berton, M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate in Surgery, Medical Department, University of Pennsylvania; Surgeon to Philadelphia General Hospital; Chief Surgeon to the American Stomach Hospital. 2012 Spruce St.

1905. Carpenter, Herbert B., M.D. 1805 Spruce St.

1926. Carpenter, Howard Childs, M.D., Vice-Dean for Pediatrics and Professor of Pediatric Hygiene, Graduate School of Medicine, University of Pennsylvania; Assistant Professor of Pediatrics, School of Medicine, University of Pennsylvania; Director, Department for the Prevention of Disease, Children's Hospital. 1805 Spruce St.

1895. Carpenter, John T., M.D., Attending Ophthalmologist to the Bryn Mawr Hospital 1737 Chestnut St.

1917. Carson, John B., M.D., Physician to Episcopal Hospital; Assistant Physician, Pennsylvania Hospital. 1802 Pine Street.

1922. Case, Eugene A., M.D., Professor of Morbid Anatomy, Graduate School of Medicine, University of Pennsylvania; Assistant Pathologist, Philadelphia General Hospital. Lansdowne, Pa.

1892. Cattell, Henry W., A.M., M.D., Editor of the International Clinics. Box 311, Burlington, N. J.

1900. Chance, Burton, M.D., Attending Surgeon to the Wills Eye Hospital; Consulting Ophthalmologist Eastern Pennsylvania Institution for the Feeble-minded and Epileptics; Ophthalmic Surgeon to the Pennsylvania Railroad Company. 315 S. Fifteenth St.

ELECTED

1897. Cheston, Radcliffe, M.D., Visiting Physician to the Chestnut Hill Hospital; Consulting Physician to the Germantown Hospital and the the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill.

1903. Chrystie, Walter, M.D. One of the Senior Physicians to Bryn Mawr Hospital. Bryn Mawr, Pa.

1929. Clark, Eliot R., A.B., M.D., Professor of Anatomy and Director of the Department of Anatomy; School of Medicine, University of Pennsylvania. 301 St. Mark's Square.

1926. Clarke, J. Alexander, A.B., M.D., Chief Clinical Assistant, Out-Patient Department of Applied Immunology, Jefferson Hospital; Assistant Physician, Philadelphia General Hospital; Instructor in Medicine, Undergraduate School, University of Pennsylvania. 334 S. Twenty-first St.

1926. Clerf, Louis H., M.D., Instructor in Bronchoscopy and Esophagoscopy and Demonstrator of Laryngology, Jefferson Medical College; Assistant Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, University of Pennsylvania; Chief Clinical Assistant in Bronchoscopy and Esophagoscopy, Jefferson Hospital; Assistant in Bronchoscopy and Esophagoscopy, University Hospital. 1216 Walnut Street.

1910. Cloud, J. Howard, M.D., Attending Physician to the Bryn Mawr Hospital. 11 W. Montgomery Ave., Ardmore, Pa.

1903. Coates, George Morrison, A.B., M.D., Professor of Otology, Graduate School of Medicine, University of Pennsylvania; Associate Laryngologist, Pennsylvania Hospital; Consulting Otolaryngologist to the Philadelphia Orphanage, U. S. Veterans' Bureau and Base Hospital No. 49, Chester County Hospital, Lawrenceville School and to the Sharon Hospital, Sharon, Conn. 1721 Pine St.

1908. Codman, Charles A. E., M.D., Physician to the American Oncologic Hospital. 4116 Spruce St.

1922. Cohen, Leon Solis, A.B., M.D., Clinical Assistant of Roentgenology, Jefferson Medical College. 1923 Spruce St.

1907. Cohen, Myer Solis, A.B., M.D., Assistant Professor of Medicine, Graduate School of Medicine, University of Pennsylvania; Lecturer on Medical Jurisprudence and Toxicology, Woman's Medical College of Pennsylvania; Pediatrist to the Jewish and Mount. Sinai Hospitals. 2029 Spruce St.

1888. Cohen, Solomon Solis, M.D., Emeritus Professor of Clinical Medicine in the Jefferson Medical College; Emeritus Professor of Medicine and Therapeutics, Philadelphia Polyclinic

ELECTED

and College for Graduates in Medicine; Consulting Physician to the Jewish Hospital and to the Rush Hospital. 1906 Walnut St.

1920. Cole, Charles J., A.B., M.D., Visiting Physician, Philadelphia Hospital for Contagious Diseases; Physician to Out-Patient Department, Mary Drexel Home. Elkins Park, Pa.

1898. Coles, Stricker, M.D. Bryn Mawr, Pa.

*1901. Coley, Thomas Luther, A.B., M.D., Major, Medical Corps, U. S. Army. Fort Davis, Canal Zone.

1912. Copp, Owen, A.B., M.D., Consultant for the Future Development of the Pennsylvania Hospital. 4401 Market St.

1911. Cornell, Walter Stewart, A.B., M.D., Director of Medical Inspection of Public Schools of the City of Philadelphia; Chief of Medical Staff of the House of Detention; Lecturer on Osteology in the University of Pennsylvania. 1919 Cherry Street.

1914. Corson, Edward Foulke, M.D., Assistant Professor of Dermatology, Jefferson Medical College; Associate in Dermatology, Graduate School of Medicine, University of Pennsylvania; Dermatologist, Children's Hospital of Philadelphia. Medical Arts Building.

1907. Council, Malcolm S., M.D., Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Cathcart Home at Devon. Bryn Mawr, Pa.

1924. Cowan, Alfred, M.D., Assistant Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist, Philadelphia General Hospital. 1930 Chestnut St.

1904. Craig, Frank A., M.D., Instructor in Medicine in the University of Pennsylvania; Visiting Physician to the Henry Phipps Institute, University of Pennsylvania; Visiting Physician to the White Haven Sanatorium; Tuberculosis Consultant to the Presbyterian Hospital. 2011 Pine Street.

1907. Crampton, George S., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital and the Philadelphia Hospital for Contagious Diseases; Assistant Surgeon to the Wills Hospital; Professor of Ophthalmology in the Graduate School of Medicine, University of Pennsylvania; Ophthalmologist to the Philadelphia Orphanage. 2031 Locust St.

1924. Crawford, Baxter Lindsey, M.D., Associate in Pathology, Jefferson Medical College; Chief of Laboratory Service, Jefferson Hospital; Assistant Pathologist, Philadelphia General Hospital. Jefferson Hospital, Tenth and Sansom Sts.

ELECTED

1920. Creighton, William J., B.A., M.D., Assistant Ophthalmic Surgeon, Germantown Hospital and Dispensary; Assistant Dispensary Surgeon, Department Ophthalmology, University Hospital; Instructor in Ophthalmology, University of Pennsylvania Medical School. 258 S. Eighteenth St.

1920. Cross, George Howard, M.D., Ophthalmologist to the Chester Hospital; Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania. Chester, Pa.

1917. Cross, Sumner H., A.B., M.D., Physician to the Abington Memorial Hospital, Abington, Pa. Box 126, Jenkintown, Pa.

1921. Crossan, Edward T., M.D., Associate Surgeon, Episcopal Hospital; Associate in Surgery, University of Pennsylvania; Assistant Surgeon Orthopedic Hospital. 257 S. Sixteenth Street.

*1924. Crowell, Bowman C., A.B., M.D., C.M., Associate Director, American College of Surgeons; Director of Clinical Research. 40 E. Erie St., Chicago, Ill.

1904. Cruice, John M., M.D., Physician to St. Agnes and St. Joseph's Hospitals and to the Henry Phipps Institute of the University of Pennsylvania; Instructor in Medicine in the University of Pennsylvania. 406 S. Twenty-second St.

*1910. Cummins, W. Taylor, M.D., Pathologist to the Southern Pacific Hospital; Director of the Mary W. Harriman Research Laboratory, San Francisco, Calif.

1902. Currie, Charles A., M.D., Physician to the Germantown Hospital. West Walnut Lane, Germantown.

1896. Da Costa, John Chalmers, M.D., Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General and St. Joseph's Hospital. 2047 Walnut St.

1887. Daland, Judson, M.D., Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 317 S. Eighteenth St.

1919. Davies, John R., Jr., M.D., Chief to the Out-Patient Nose, Throat and Ear Department of the Pennsylvania, Bryn Mawr and Chestnut Hill Hospitals. 302 S. Nineteenth St.

1896. Davis, Charles N., M.D., Dermatologist to the Pennsylvania Hospital; Consulting Dermatologist to St. Agnes' Hospital; Assistant Physician to the Dispensary for Skin Diseases in the Howard Hospital. 1931 Spruce St.

ELECTED

1916. Davis, Warren B., M.D., Rhinologist, Laryngologist, and Otologist, St. Agnes' Hospital; Instructor in Surgery, Jefferson Medical College; Assistant Surgeon, Frankford Hospital. 135 S. Eighteenth St.

1900. Davisson, Alex. Heron, M.D. 4514 Springfield Ave.

1894. Deaver, Harry C., M.D., Surgeon to the Episcopal Hospital and to the Children's Hospital of the Mary J. Drexel Home; Surgeon-in-Chief to the Kensington Hospital for Women. 337 S. Eighteenth St.

1887. Deaver, John B., M.D., D.Sc., LL.D., Professor of Surgery in the Graduate School of Medicine; Emeritus Professor of Surgery in the School of Medicine, University of Pennsylvania; Surgeon-in-Chief to the Lankenau Hospital. 1830 DeLancey Street.

1902. Dehoney, Howard, M.D. 240 S. Thirteenth St.

1924. Deichler, L. Waller, M.D., Assistant Surgeon, Wills Hospital; Instructor in Ophthalmology, University of Pennsylvania; Ophthalmologist, Philadelphia General Hospital. 1737 Chestnut St.

1923. De Long, Perce, M.D., Associate in Ophthalmic Pathology in the Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, Wills Eye Hospital; Assistant Neuropathologist, Philadelphia General Hospital. 1904 Chestnut Street.

1885. Dercum, Francis X., A.M., M.D., Ph.D., Sc.D., President, American Philosophical Society, Professor Emeritus of Nervous and Mental Diseases in the Jefferson Medical College; Foreign Corresponding Member of the Neurological Society of Paris; Honorary Member of the Psychiatric and Neurological Society of Vienna; Corresponding Member of the Neurological Section of the Royal Society of Medicine; Chevalier de l'Ordre National de la Légion d'Honneur. 1719 Walnut St.

1928. Dewees, A. Lovett, B.A., M.D., Attending Physician, Bryn Mawr Hospital. Haverford, Pa.

1912. Dewey, J. Hiland, Ph.B., M.D., Assistant Surgeon to Wills Hospital; Ophthalmic Surgeon to St. Francis' Hospital, Trenton, N. J. 1436 Diamond St.

*1911. Dickson, Frank D., M.D. 1807 Federal Reserve Bank Building, Kansas City, Mo.

1908. Dillard, Henry K., Jr., M.D., Physician to the Out-Patient Department of the Pennsylvania Hospital; Physician to the Dispensary of the Mary J. Drexel Home. 234 S. Twentieth Street.

ELECTED

1924. Dillon, Edward S., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Assistant Physician, Department of Metabolism, Philadelphia General Hospital; Instructor in Medicine, School of Medicine, University of Pennsylvania. 2040 Pine St.

1920. Diven, John, A.B., M.D., Pediatrician to St. Christopher's Hospital and Babies' Hospital of Philadelphia. 326 S. Nineteenth St.

1920. Doane, Joseph Chapman, M.D., Associate Professor of Medicine, Temple University; Medical Director, Jewish Hospital; Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 2011 Chestnut St.

*1897. Dorland, W. A. Newman, A.M., M.D., Professor of Gynecology in the Post-graduate Medical School of Chicago; Professor of Obstetrics in the Chicago College of Medicine and Surgery; Visiting Obstetrician to Cook County Hospital. 622 Stratford Place, Chicago, Ill.

1907. Dorrance, George Morris, M.D., Professor of Maxillo-Facial Surgery, Thomas Evans Institute, University of Pennsylvania; Surgeon to St. Agnes' Hospital. 2025 Walnut St.

1902. Downs, Robert N., Jr., M.D., Surgeon to the Dispensary of the Germantown Hospital. 6008 Greene St. Germantown.

1910. Drayton, William, Jr., M.D., Physician to the Philadelphia Hospital for Contagious Diseases; Physician to the Pennsylvania Institute for the Instruction of the Blind 1820 Pine Street.

1911. Earnshaw, Henry Culp, M.S., M.D., Attending Physician to the Hospital of the Good Shepherd, Rosemont; Assistant Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Bryn Mawr Children's Hospital; Pennsylvania Railroad Surgeon. Bryn Mawr, Pa.

*1887. Edwards, William A., M.D., Professor of Pediatrics in the Medical Department of the University of California. R. D. 2, Box 105, El Cajon, Calif.

1924. Egbert, Seneca, M.D., Professor of Hygiene, School of Hygiene and Public Health, University of Pennsylvania. Wayne, Pa.

1911. Eliason, Eldridge L., B.A., M.D., Sc.D., Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University Hospital and to the Howard Hospital; Assistant Surgeon to the Philadelphia General Hospital and the American Stomach Hospital. 326 S. Nineteenth St.

1928. Ellison, Richard T., B.S., M.D., Instructor in Medicine, School of Medicine, University of Pennsylvania; Assistant Physician in Charge of Heliotherapy at the Home for Con-

ELECTED

sumptives, Chestnut Hill; Assistant Physician, Presbyterian Hospital. 111 Rex Ave.

1904. Elmer, Walter G., B.S., M.D., Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Orthopedic Surgeon to the Hospital of the Graduate School of Medicine and to the Philadelphia General Hospital. 1801 Pine St.

1896. Ely, Thomas C., A.M., M.D. 3912 Chestnut St.

†1893. Eshner, Augustus A., M.D., Consulting Physician to Mercy Hospital. 1019 Spruce St.

*1905. Evans, Joseph S., Jr., A.B., M.D., Professor of Medicine, Medical School, University of Wisconsin; Physician to State of Wisconsin General Hospital; Consulting Physician, Madison General and St. Mary's Hospitals. 1300 University Ave., Madison, Wis.

1905. Evans, William, M.D. 500 W. Gay St., West Chester.

1912. Eves, Curtis C., M.D., Otolaryngologist to the Pennsylvania Hospital; Consultant Otolaryngologist to the Philadelphia General Hospital. 1910 Spruce St.

1922. Farley, David L., B.S., M.D., Associate in Medicine, University of Pennsylvania; Physician to Pennsylvania Hospital; Chief of Out-Patient Medical Clinic, Pennsylvania Hospital. 1725 Pine St.

†1903. Farr, Clifford B., A.M., M.D., Director of Laboratories, Pennsylvania Hospital, Department for Mental and Nervous Diseases. Bryn Mawr, Pa.

1893. Farr, William W., M.D., Physician to the Leamy Home. 121 Maplewood Ave., Germantown.

‡1884. Fenton, Thomas H., M.D. 1319 Spruce St.

1907. Fetterolf, George, A.B., M.D., Sc.D., Professor of Otolaryngology, School of Medicine, University of Pennsylvania. 2010 Spruce St.

1924. Fewell, Alexander G., M.D., Assistant Professor of Ophthalmology, Graduate School of Medicine and Instructor in Ophthalmology in the School of Medicine, University of Pennsylvania; Ophthalmic Surgeon to the Episcopal Hospital. 1924 Pine St.

1907. Fife, Charles A., A.B., M.D., Associate Professor of Pediatrics in the Graduate School of Medicine of the University of Pennsylvania; Pediatrist to the Presbyterian Hospital; Physician to the St. Christopher's Hospital for Children;

ELECTED

Assistant Physician to the Philadelphia General Hospital. 2104 Spruce St.

1884. Fisher, Henry M., A.B., M.D. Jenkintown, Pa.

1910. Fisher, John Monroe, M.D., Associate Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Philadelphia, St. Agnes' and Pottstown Hospitals; Assistant Gynecologist to the Jefferson Medical College Hospital. 345 S. Nineteenth St.

1928. Fitz-Hugh, Thomas, Jr., A.B., A.M., M.D., Assistant Attending Physician, University Hospital; Attending Physician, Delaware County Hospital; Instructor in Medicine, University of Pennsylvania. 2020 Locust St.

1928. Flick, John Bernard, M.D., Chief Clinical Assistant in Surgery, Division B, Jefferson Hospital; Assistant Surgeon, Pennsylvania and Bryn Mawr Hospitals; Surgeon, Eagleville Sanatorium for Consumptives, Eagleville, Pa. 1608 Spruce Street.

1888. Flick, Lawrence F., M.D. 736 Pine St.

1916. Forst, John R., M.D. 166 W. Coulter St., Germantown.

1908. Foulkrod, Collin, M.D., Obstetrician to the Presbyterian Hospital; Assistant Demonstrator of Obstetrics in Jefferson Medical College. 3910 Chestnut St.

1908. Fox, Herbert, M.D., Director of the William Pepper Clinical Laboratory and Professor of Comparative Pathology, School of Medicine, University of Pennsylvania; Pathologist to the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia; Pathologist to the Rush Hospital. Haverford, Pa.

†1885. Fox, Joseph M., M.D. Torresdale, Pa.

1906. Fraley, Frederick, Jr., A.B., M.D., Associate in Pediatrics, Graduate School of Medicine, University of Pennsylvania. Overbrook, Pa.

1897. Frazier, Charles H., A.B., M.D., Sc.D., John Rhea Barton Professor of Surgery, University of Pennsylvania. 133 S. Thirty-sixth St.

1928. Fuller, Daniel Hunt, A.B., A.M., M.D., Medical Director, Department for Men, Pennsylvania Hospital for Mental and Nervous Diseases. 111 N. Forty-ninth St.

1916. Funk, Elmer Hendricks, M.D., Clinical Professor of Medicine and Therapeutics in the Jefferson Medical College; Assistant Physician to the Pennsylvania and Jefferson Hospitals; Visiting Physician to the White Haven Sanatorium. 269 S. Nineteenth St.

ELECTED

1899. Gamble, Robert, G., M.D., one of the Attending Physicians to the Bryn Mawr Hospital. Haverford, Pa.

1912. Gaskill, Henry Kennedy, M.D. S. E. Cor. Nineteenth and Spruce Sts.

*1913. Gates, Nathaniel, M.D. 10 Peterboro Ave., Detroit, Mich.

1917. Gerhard, Arthur Howell, M.D. 1615 N. Delaware Ave.

1902. Ghriskey, Albert A., M.D. 3936 Walnut St.

1899. Gibbon, John H., M.D., Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania Hospital and Consulting Surgeon to the Bryn Mawr Hospital. 1608 Spruce Street.

1920. Gill, A. Bruce, A.B., M.D., Professor of Orthopedics, University of Pennsylvania; Surgeon to the Orthopedic Hospital; Orthopedic Surgeon to the Presbyterian Hospital; Chief Surgeon to the Widener Memorial Industrial Training School for Crippled Children. The Lenox, Thirteenth and Spruce Streets.

1927. Gilmour, William Rodger, A.B., A.M., M.D., Assistant Surgeon, Philadelphia General and Methodist Hospitals; Instructor in Anatomy, University of Pennsylvania; Associate Professor of Operative Surgery and Surgical Anatomy, Woman's Medical College. 1737 Chestnut St.

1897. Girvin, John H., M.D., Gynecologist to the Presbyterian Hospital; Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania. 2120 Walnut St.

1920. Githens, Thomas Stotesbury, M.D., Chief Pharmacologist, H. K. Mulford Company. Alden Park Manor, Germantown.

1906. Gittings, J. Claxton, M.D., Professor of Pediatrics, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Children's Hospital of Philadelphia. 1828 Pine St.

1905. Given, Ellis E. W., M.D., Surgeon to the Philadelphia Freemasons Memorial Hospital of the Masonic Home, Elizabethtown, Pa. 2714 Columbia Ave.

1894. Gleason, E. B., S.B., M.D., LL.D., Professor of Otology in the Graduate School of Medicine, University of Pennsylvania. 2112 Pine St.

1906. Goepp, R. Max, M.D. 518 Medical Arts Building.

1906. Goldberg, Harold G., M.D., Ophthalmic Surgeon to the Episcopal and Misericordia Hospitals, Kensington Hospital for Women and Baltimore and Ohio Railroad. 2213 Walnut Street.

*1908. Goodman, Edward H., M.D. Dorset, Vt.

ELECTED

1905. Gordon, Alfred, M.D., Neurologist to the Mt. Sinai, the Northwestern General, and the Douglass Memorial Hospitals. 1812 Spruce St.

1928. Gordon, Burgess Lee, A.B., M.D., Director of the Department for Diseases of the Chest, Jefferson Hospital; Assistant Professor in Medicine, Jefferson Medical College. 1832 Spruce St.

1894. Graham, Edwin E., M.D., Professor of Pediatrics in the Jefferson Medical College; Pediatrist to the Jefferson and the Philadelphia General Hospitals; Physician to the Franklin Reformatory Home. 1713 Spruce St.

1926. Grant, Francis C., A.B., M.D., Assistant Professor of Neurosurgery and Associate in Surgery, School of Medicine, University of Pennsylvania; Associate in Neuro-Surgery, Graduate School of Medicine, University of Pennsylvania; Visiting Surgeon, Department of Neurological Surgery, Philadelphia General Hospital. 133 S. Thirty-sixth St.

1904. Grayson, Charles P., M.D., Emeritus Professor of Laryngology in the University of Pennsylvania; Otolaryngologist to the Philadelphia General Hospital. 262 S. Fifteenth St.

1910. Greenman, Milton J., M.D., Sc.D., Director of the Wistar Institute of Anatomy and Biology. Wistar Institute of Anatomy and Biology, Thirty-sixth St. and Woodland Ave.

1883. Griffith, J. P. Crozer, A.B., M.D., Ph.D., Professor of Pediatrics in the Graduate School of Medicine, University of Pennsylvania; Corresponding Member of the Société de Pédiatrie de Paris; Physician to the Children's Hospital of Philadelphia. 1810 Spruce St.

1912. Griscom, J. Milton, B.S., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Attending Surgeon to the Wills Hospital. 2213 Walnut St.

1911. Gummey, Frank Bird, M.D., Visiting Physician to the Germantown Hospital and Dispensary; Visiting Physician to the Midnight Mission. 5418 Greene St., Germantown.

*1902. Gwyn, Norman B., M.D., Clinician in Medicine, Toronto General Hospital; Clinician in Medicine, Medical Faculty, University of Toronto School. 109 Madison Ave., Toronto, Canada.

1894. Hamill, Samuel McC., M.D., Pediatrist to the Presbyterian Hospital; Pediatrist to St. Vincent's Home. 1822 Spruce St.

1897. Hand, Alfred, Jr., M.D., Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Visiting

ELECTED

Physician to the Children's Hospital, to the Children's Hospital of the Mary J. Drexel Home and to the Methodist Hospital. 1724 Pine St.

1886. HANSELL, HOWARD F., M.D., Emeritus Professor of Ophthalmology in the Jefferson Medical College. N. E. Cor. Seventeenth and Walnut Sts.

1889. HARE, HOBART A., M.D., LL.D., Professor of Therapeutics, Materia Medica, and Diagnosis in the Jefferson Medical College. 1801 Spruce St.

1929. HARRISON, FRANCIS G., M.D., Assistant Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Assistant Urologist, Out-Patient Department, Presbyterian Hospital. 1900 Spruce St.

1903. HART, CHARLES D., A.M., M.D., Inspector and Secretary of the Eastern State Penitentiary; National Executive Committee and Chairman of the Philadelphia Committee, Boy Scouts of America. Chestnut Hill.

1926. HARTMAN, FREDERICK L., A.B., M.D., Clinical Associate in Medicine, Lankenau Hospital; Assistant Instructor in Pathology, University of Pennsylvania; Assistant Pathologist, Visiting Staff of University and Philadelphia General Hospitals. 1914 Pine St.

1907. HATFIELD, CHARLES JAMES, A.B. (Princeton), M.D., Executive Director of the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis; Visiting Physician to the White Haven Sanatorium. Phipps Institute, Seventh and Lombard Sts.

1928. HAYMAN, JOSEPH M., JR., A.B., M.D., Associate Professor of Medicine, Western Reserve University; Associate Physician, Lakeside Hospital. Cleveland, Ohio.

1911. HEED, CHARLES R., M.D., Ophthalmologist to Girard College; Assistant Ophthalmologist to the Jefferson Medical College Hospital. 1205 Spruce St.

1901. HEISLER, JOHN C., M.D., Professor of Anatomy, University of Pennsylvania. 3829 Walnut St.

1903. HENRY, J. NORMAN, M.D., Physician to the Pennsylvania Hospital; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Assistant Physician to the Philadelphia General Hospital. 1906 Spruce St.

1927. HERMAN, LEON, B.S., M.D., Urologist, Methodist Hospital; Assistant Surgeon in Charge of Urology, Pennsylvania Hospital. 1521 Pine St.

ELECTED

1891. Hewson, Addinell, A.B., A.M., M.D., Professor of Anatomy and Histology in the Temple University; Surgeon to Memorial Hospital, Roxborough. 257 S. Sixteenth St.

1924. Hewson, William, A.B., M.D., Assistant in Otology, Graduate School of Medicine, University of Pennsylvania; Otolaryngologist, Pennsylvania Institution for Instruction of Blind and the Shriners' Hospital for Crippled Children; Assistant Otolaryngologist, Memorial Hospital. 6300 Overbrook Ave.

1909. Higbee, William S., M.D., President of the Pennsylvania State Board of Examiners for Registration of Nurses. 5121 Pine St.

1897. Hinkle, William M., M.D., Associate in Otology in the Graduate School of Medicine, University of Pennsylvania; Lecturer on the Anatomy and Physiology of the Vocal Organs in the National School of Elocution and Oratory. 923 N. Sixty-fourth St.

*1892. Hinsdale, Guy, A.M., M.D. White Sulphur Springs, W. Va.

1888. Hirst, Barton Cooke, A.B., M.D., LL.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Gynecologist to the Philadelphia General and the Howard Hospitals. 1821 Spruce St.

1924. Hirst, John C., 2nd, A.B., M.D., Assistant Professor of Obstetrics, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Assistant Obstetrician, University Hospital; Obstetrician to St. Agnes' Hospital; Gynecologist to Orthopedic Hospital. 1918 Pine St.

*1908. Hitchens, Arthur Parker, M.D., M.C., U.S.A., in charge, 6th Corps Area. Laboratory, Fort Sheridan, Ill.

1905. Hodge, Edward Blanchard, A.B., M.D., Surgeon to the Presbyterian and the Germantown Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania; Associate Surgeon to the Pennsylvania Hospital; Surgeon-in-Chief to Chester County Hospital, West Chester, Pa. 2019 Spruce St.

1906. Holloway, Thomas B., M.S., M.D., Sc.D., Professor of Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist, Orthoepdic Hospital, and in Department of Neurology, Philadelphia General Hospital; Ophthalmologist to the Pennsylvania Institution for the Instruction of the Blind at Overbrook. 1819 Chestnut Street.

1914. Hooker, Richard S., M.D., Assistant Physician to the Episcopal Hospital, and to the Philadelphia Orthopedic Hospital and Infirmary for Nervous Diseases. 2147 N. Howard St.

ELECTED

1919. Hopkins, Arthur H., B.S. (Haverford), M.D. 1726 Pine St.

1925. Hopkinson, R. Dale, M.D., Registrar and Assistant Physician, Abington Memorial Hospital. Jenkintown, Pa.

1928. Houser, Karl M., Ph.B., M.D., M.Sc., Instructor in Otolaryngology, University of Pennsylvania; Assistant in Otolaryngology, University Hospital; Otolaryngologist, Delaware County Hospital. 1826 Pine St.

1908. Hoyt, Daniel M., M.D., Assistant Visiting Physician to the Philadelphia General Hospital. The Tracy, Thirty-sixth and Chestnut Sts.

*1912. Huber, G. Carl, M.D., Professor of Anatomy and Director of the Anatomic Laboratories and Dean of the Graduate School, University of Michigan. 1330 Hill St., Ann Arbor, Mich.

1892. Hughes, William E., M.D., Visiting Physician to the Philadelphia General Hospital; Consulting Physician to the Presbyterian Hospital. 3945 Chestnut St.

1923. Hume, John E., A.B., M.D., Visiting Physician, Medical Department, Howard Hospital. N. E. Cor. Twentieth and Chestnut Sts.

*1912. Hunter, John W., B.S., M.D. McDaniel, Md.

1921. Hunter, Robert J., M.D., Laryngologist, Philadelphia General Hospital; Associate Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 2011 Chestnut Street.

1926. Husik, David N., M.D., Professor of Otology, Graduate School of Medicine, University of Pennsylvania; Laryngologist, Philadelphia General, Mount Sinai and American Stomach Hospitals. 1930 Chestnut St.

1898. Hutchinson, James P., M.D., Consulting Surgeon to the Pennsylvania and to the Methodist Hospitals. Penn Mutual Life Insurance Company, Sixth and Walnut Sts.

1921. Ivy, Robert H., D.D.S., M.D., Professor of Maxillo-Facial Surgery, Graduate School of Medicine, University of Pennsylvania; Plastic Surgeon to the Hospitals of the Graduate School of Medicine, University of Pennsylvania; Oral Surgeon, Episcopal Hospital; Consultant in Maxillo-Facial Surgery, Walter Reed General Hospital, Washington, D.C. 1503 Medical Arts Building.

1917. Jackson, Chevalier, M.D., Sc.D., Professor of Bronchoscopy and Esophagoscopy, Jefferson Medical College; Professor of

ELECTED

Bronchoscopy and Esophagoscopy, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Lecturer on Bronchoscopy and Esophagoscopy, Woman's Medical College. 235 S. Fifteenth St.

*1885. Jackson, Edward, A.M., M.D., Sc.D., Emeritus Professor of Ophthalmology in the University of Colorado; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic; Secretary of State Commission for the Blind of Colorado. 217 Imperial Building, Denver, Colo.

1906. Jacobs, Francis Brinton, B.S., M.D., Pediatrist to the Chester County Hospital. West Chester, Pa.

1922. Jameson, Howard Leon, M.D., Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 2133 S. Sixteenth St.

1920. Janvier, G. Victor, M.D., Associate in Obstetrics, School of Medicine, University of Pennsylvania; Assistant Obstetrician, University Hospital; Assistant Obstetrician and Gynecologist, Philadelphia General and Howard Hospitals; Cystoscopist to the Obstetric and Gynecologic Department of the Delaware County Hospital. Lansdowne, Pa.

1913. Jefferys, William Hamilton, A.B., A.M., M.D. Rosemont, Pa.

1919. Jenks, Horace H., A.B., M.D., Medical Director, Associated Medical Clinics; Assistant Visiting Physician to the Children's Hospital; Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Physician to St. Christopher's Hospital for Children. 918 Clinton St.

1928. John, Rutherford Lewis, B.S., M.D., Instructor in Surgery, School of Medicine, University of Pennsylvania; Associate Surgeon in Charge of Orthopedics, Episcopal Hospital; Orthopedic Surgeon to St. Christopher's Hospital; Assistant Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases. 256 S. Twenty-first St.

1926. Johnson, George Ernest, M.D. 5341 Chester Ave.

1898. Johnson, Russell H., A.B. (Princeton), M.D., Physician to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill, Philadelphia.

1928. Johnson, William N., A.B., M.D., Consulting Physician, Germantown Hospital. 6430 Germantown Ave.

1918. Jonas, Leon, M.D. 1726 Pine St.

1900. Jones, Charles James, A.M., M.D., LL.D., Ophthalmic Surgeon to St. Joseph's Hospital; Ophthalmic Surgeon to the House of the Good Shepherd, Germantown; Consulting

ELECTED

Ophthalmologist to St. Vincent's Home. 626 Medical Arts Building.

1924. Jones, Harold W., M.D., Demonstrator of Medicine, Jefferson Medical College; Assistant Physician, Philadelphia General Hospital. 1930 Chestnut St.

1913. Jones, John F. X., B.S., A.B., A.M., M.D., Surgeon to St. Joseph's, Misericordia and St. Agnes' Hospitals. 1737 Chestnut St.

1900. Jopson, John H., M.D., Professor of Clinical Surgery, University of Pennsylvania; Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Presbyterian and the Children's Hospitals. 1824 Pine St.

1900. Judson, Charles F., A.B., M.D., Physician to Out-Patient Department of the Lankenau Hospital and to the Southern Home for Children. 1005 Spruce St.

1902. Jump, Henry D., M.D., Professor of Applied Therapeutics and Clinical Medicine, Woman's Medical College; Physician to Philadelphia General and Misericordia Hospitals. 2019 Walnut St.

1903. Kalteyer, Frederick J., M.D., Associate Professor of Medicine, Jefferson Medical College; Assistant Physician, Jefferson Medical College Hospital; Consulting Physician to the Pottstown Hospital, Pottstown, Pa. 1530 Locust St.

*1910. Karsner, Howard T., M.D., Professor of Pathology in the Western Reserve University Medical School. 2109 Adelbert Rd., Cleveland, Ohio.

1926. Kaufman, Isadore, M.D., Associate in Medicine, University of Pennsylvania; Medical Director, Kensington Dispensary for Tuberculosis; Associate Clinical and Sociological Director, Phipps Institute; Visiting Physician to White Haven Sanatorium. 316 Otis Building.

1923. Kay, James, M.D., Visiting Physician, Episcopal Hospital; Associate Professor in Physical Diagnosis, Medical School, Temple University. 600 W. Olney Ave.

1920. Keating, Peter McCall, M.D. Medical Arts Building, San Antonio, Texas.

1924. Keeler, J. Clarence, M.D., Associate Professor of Otology, Jefferson Medical College and Hospital; Assistant in Otolaryngology, Germantown Hospital; Consultant Otolaryngologist, Pottstown Hospital, Pa., and Newcombe Hospital, Vineland, N. J. Medical Arts Building.

ELECTED

†1867. Keen, William W., M.D., LL.D. (Hon.), Ph.D. (Brown, Upsala, etc.), (Hon.) Sc.D. (Jefferson and Harvard), Dr., Honoris Causa, University of Paris; (Hon.) F.R.C.S. (Eng., Edin. and Ireland). 1520 Spruce St.

1912. Keene, Floyd E., M.D., Goodell Professor of Gynecology in the School of Medicine, and Professor of Gynecology in the Graduate School of Medicine, University of Pennsylvania; Gynecologist to the University Hospital; Gynecologist to the Chestnut Hill Hospital. 133 S. Thirty-sixth St.

1913. Kelly, Francis Joseph, M.D. 2211 Locust St.

*1887. Kelly, Howard A., A.B., M.D., LL.D. (Aberdeen, Wash. and Lee, and Univ. of Pa.), Professor of Gynecology in Johns Hopkins University and Gynecologist to the Johns Hopkins Hospital, Baltimore, Md.; Hon. Fellow of the Edinburgh Obstetrical Society, the Royal Academy of Medicine of Ireland, and of the Glasgow Obstetrical and Gynecological Society. 1418 Eutaw Place, Baltimore, Md.

1909. Kelly, James A., A.M., M.D., Visiting Surgeon to St. Mary's and Memorial Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania; Assisting Visiting Surgeon to St. Joseph's Hospital. 1900 S. Rittenhouse Square.

1912. Kelly, Thomas C., A.M., M.D., Associate in Medicine, University of Pennsylvania; Assistant Professor of Medicine, Graduate School, University of Pennsylvania; Pediatrist to St. Christopher, Misericordia and St. Mary's Hospitals; Assistant Physician, Philadelphia General Hospital. 105 School Lane, Germantown.

1898. Kempton, Augustus F., M.D. 2118 Pine St.

1905. Kercher, Delno E., M.D. 1534 Pine St.

1921. Kern, Richard A., A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Assistant Physician, University Hospital; Associate in Medicine, Graduate School of Medicine, University of Pennsylvania. University Hospital, Thirty-sixth and Spruce Sts.

1920. Klauder, Joseph Victor, A.B., M.D., Professor of Dermatology, Woman's Medical College; Associate Professor, Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Dermatologist, Misericordia, Wills and Abington Memorial Hospitals; Chief of Clinic, Philadelphia General Hospital. 1934 Spruce St.

1920. Klein, Thomas, M.D., Professor of Applied Therapeutics, Medical School, Temple University; Associate Professor of

ELECTED

Medicine, Graduate School, University of Pennsylvania; Physician to Samaritan and Philadelphia General Hospitals. 250 S. Eighteenth St.

1913. Klopp, Edward J., M.D., Associate in Surgery in the Jefferson Medical College; Assistant Surgeon to the Jefferson Hospital; Surgeon and Chief of the Out-Patient Clinic of the Pennsylvania Hospital; Surgeon to the Delaware County Hospital. 1611 Spruce St.

1908. Knipe, Jay C., M.D., Ophthalmologist to the Jewish and Mary J. Drexel Hospitals; Associate in Ophthalmology, Jefferson Medical College; Chief of Eye Clinic, Jefferson Hospital. 1737 Chestnut St.

1919. Knipe, Norman Leslie, Ph.B. (Cornell); M.D., Gynecologist, St. Mary's Hospital; Associate Gynecologist, American Stomach Hospital. 2018 Chestnut St.

1908. Knowles, Frank Crozer, M.D., Professor of Dermatology, Jefferson Medical College; Dermatologist to the Presbyterian and Children's Hospitals; Chief of Clinic, Pennsylvania Hospital. 2035 Spruce St.

1925. Knox, Harry E., M.D., Instructor in Surgery, School of Medicine, University of Pennsylvania; Assistant Surgeon, Germantown, St. Christopher's and Episcopal Hospitals; Surgeon to Philadelphia Hospital for Contagious Diseases. 719 Sixty-sixth Ave., Oak Lane, Phila.

1914. Kolmer, John A., M.D., Dr. P.H., M.Sc., D.Sc., LL.D., Professor of Pathology and Bacteriology, Graduate School of Medicine, University of Pennsylvania; Head of the Department of Pathology and Bacteriology Research Institute for Cutaneous Medicine; Consulting Pathologist to St. Vincent's, Misericordia, Memorial and Jeanes Hospitals. Cynwyd, Pa.

1904. Krauss, Frederick, M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmic Surgeon to St. Christopher's Hospital for Children; Laryngologist to the Abington Hospital. 1930 Chestnut St.

1914. Krumbhaar, Edward B., A.B., Ph.D., M.D., Professor of Pathology, School of Medicine, and Graduate School of Medicine, University of Pennsylvania. Box 4310, Chestnut Hill.

1900. Krusen, Wilmer, M.D., Professor of Gynecology in the Medical Department of Temple University; Chief Gynecologist to the Samaritan and the Garretson Hospitals; Consulting Gynecologist to the Charity and Mercy Hospitals. 127 N. Twentieth St.

ELECTED

1904. Landis, Henry R. M., M.D., Professor of Clinical Medicine in the School of Medicine, and Director of the Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania; Visiting Physician to the White Haven Sanatorium. 1817 Pine St.

1907. Langdon, H. Maxwell, M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor of Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist of the Presbyterian, Orthopedic and Children's Hospitals. 1530 Locust St.

1922. Lawrance, Stuart J., M.D., Obstetrician, St. Mary's Hospital. 1332 Spruce St.

1926. Laws, George M., B.S., M.D., Associate Gynecologist, Presbyterian Hospital; Gynecologist, American Hospital for Diseases of the Stomach. 1907 Spruce St.

1920. Leavitt, Frederick Headley, M.D., Associate in Neurology, Graduate School of Medicine, University of Pennsylvania; Assistant Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 1527 Pine St.

1904. Le Boutillier, Theodore, M.D., Assistant Professor, Epidemic Contagious Diseases, Graduate School of Medicine, University of Pennsylvania; Senior Pediatrist, Philadelphia Hospital for Contagious Diseases; Visiting Physician, Babies' Hospital, North Philadelphia. 2017 Spruce St.

1908. Lee, Walter Estell, M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Pennsylvania, Germantown, Bryn Mawr and Children's Hospitals, and to the Hospital of the Graduate School of Medicine, University of Pennsylvania. 905 Pine St.

1903. Leffmann, Henry, A.M., M.D., D.D.S., Ph.D., Honorary Professor of Chemistry, Wagner Free Institute of Science; Emeritus Pathological Chemist, Jefferson Hospital; Lecturer on Research, Philadelphia College of Pharmacy and Science. 1729 N. Seventeenth St.

1892. Leidy, Joseph, M.D., Officier d'instruction publique, France; Consulting Physician to the Pennsylvania Training School for Feeble-minded Children. 1713 Walnut St.

1920. Leopold, Simon S., M.D., Associate in Medicine, University of Pennsylvania; Assistant Physician, University Hospital. 2025 Spruce St.

1915. Lewis, Fielding O., M.D., Associate in Laryngology in the Jefferson Medical College Hospital; Operating Clinical Chief of the Laryngological Dispensary and Clinical Assistant

ELECTED

of the Otological Dispensary of the Jefferson Medical College Hospital; Laryngologist of the Philadelphia General Hospital. 261 S. Seventeenth St.

‡1911. Lewis, Paul A., M.D. Princeton, N. J.

1904. Lindauer, Eugene, M.D., Assistant Neurologist to the Philadelphia General and Polyclinic Hospitals; Instructor in Neurology, Graduate School of Medicine, University of Pennsylvania. 6451 N. Broad St.

1927. Lindsey, Walter H., A.B., M.D., Associate Physician, Episcopal Hospital; Associate in Cardiology, Graduate School of Medicine, University of Pennsylvania. S. E. Cor. Seventeenth and Arch Sts.

1886. Lloyd, J. Hendrie, A.M. (Princeton), M.D., Neurologist to the Methodist Episcopal Hospital; Consulting Neurologist to the State Asylum for the Chronic Insane at Wernersville, and to the Pennsylvania Training School for Feeble-minded Children at Elwyn. 4057 Spruce St.

1907. Lodholz, Edward, M.D., Isaac Ott Professor of Physiology, Graduate School of Medicine, University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1893. Longaker, Daniel, M.D., Consulting Obstetrician to the Kensington Hospital for Women. 1806 Spruce St.

1907. Loux, Hiram R., M.D., Professor of Genito-urinary Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General Hospital. Medical Arts Building, Sixteenth and Walnut Sts.

1921. Lucké, Baldwin, Dr. P.H., M.D., Assistant Pathologist, University and Philadelphia General Hospitals; Associate Professor of Pathology, School of Medicine, and Assistant Professor of Pathology in the Graduate School of Medicine, University of Pennsylvania. Medical School, University of Pennsylvania.

1924. Ludy, John B., A.B., A.M., M.D., Dermatologist to Pennsylvania, Lankenau, Methodist and Delaware County Hospitals. Medical Arts Building.

1923. Lueders, Charles W., A.B., M.D., Gastroenterologist and Chief of Clinic, Pennsylvania Hospital. 1930 Chestnut St.

1929. Lull, Clifford B., M.D., Demonstrator in Obstetrics, Jefferson Medical College; Attending Physician, Department of Gynecology and Obstetrics, Philadelphia General and Delaware County Hospitals; Assistant Obstetrician, Lying-in and Jefferson Hospitals. 1731 Pine St.

ELECTED

1919. Lynch, Frank B., Jr., M.D., Dickson Fellow in Bacteriology to the Pepper Laboratory of Clinical Medicine, University of Pennsylvania; Serologist, University Hospital; Instructor in Pathology, Evans Institute, University of Pennsylvania. 6028 Columbia Ave.

1914. Lyon, B. B. Vincent, A.B. (Williams Coll.), M.D. (Johns Hopkins), Associate in Medicine, Jefferson Medical College; Chief-of-Clinic, Gastro-Intestinal Department, Jefferson Hospital. 2031 Locust St.

1900. McCarthy, Daniel J., M.D., Professor of Medical Jurisprudence (George B. Wood Foundation) in the University of Pennsylvania; Neurologist to the Philadelphia General and St. Agnes' Hospitals, and to the Henry Phipps Institute. 2025 Walnut St.

1913. McCrae, Thomas, B.A., M.D., F.R.C.P. (Lond.), Professor of Medicine in the Jefferson Medical College; Physician to the Jefferson and Pennsylvania Hospitals. 1929 Spruce Street.

1895. McFarland, Joseph, M.D., Sc.D., Professor of Pathology in the School of Medicine, University of Pennsylvania; Pathologist to the Philadelphia General Hospital. 542 W. Hortter St., Germantown.

1905. McKenzie, R. Tait, M.D., LL.D., Professor of Physical Education and Director of the Department of Physical Education in the University of Pennsylvania. 2014 Pine St.

*1916. McKnight, Howard A., A.B., M.D. Tecumseh Building, Springfield, Ohio.

1915. McLean, John D., M.D. 135 S. Thirty-sixth St.

1924. McMillan, Thomas M., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Cardiologist, Philadelphia General Hospital; Instructor in Medicine, School of Medicine, University of Pennsylvania; Associate Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania. 2044 Locust St.

1924. McPhedran, F. Maurice, A.B., M.D., Associate in Medicine, School of Medicine, University of Pennsylvania; Assistant Professor of Medicine, Henry Phipps Institute. Seventh and Lombard Sts.

*1900. McReynolds, Robert Phillips, M.D. 213 S. Broadway, Los Angeles, Calif.

1910. Mackinney, William H., M.D., Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Genito-

ELECTED

urinary Surgeon, Philadelphia General Hospital; Chief of Urologic Clinic, Lankenau Hospital. 1701 Chestnut St.

1901. MacLeod, George I., M.D. Ardmore, Pa.

1914. Maier, F. Hurst, M.D., Associate in Gynecology to the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Gynecologist, Obstetrician and Consultant, Prenatal Clinic, Philadelphia General Hospital; Associate Gynecologist, St. Mary's Hospital. 2019 Walnut St.

1913. Major, Charles P., B.S., M.D., Pediatrist to the Medical Service of the Germantown Hospital; Pediatrist to the Abington Memorial Hospital. Tenth and Oak Lane.

1913. Manges, Willis F., D.Sc., M.D., Roentgenologist to the Jefferson Hospital; Clinical Professor of Roentgenology, Jefferson Medical College. 235 S. Fifteenth St.

1898. Marshall, George Morley, M.D., Laryngologist to the Philadelphia General Hospital; Laryngologist and Otologist to St. Joseph's Hospital; Associate Professor of Laryngology in the Graduate School of Medicine, University of Pennsylvania. 1819 Spruce St.

1889. Martin, Edward, M.D., Emeritus Professor of Surgical Physiology, University of Pennsylvania. 135 S. Eighteenth St.

*1911. Meigs, Edward Browning, A.B., M.D., Physiologist in the Dairy Division of the United States Department of Agriculture. 1736 M. St., N. W., Washington, D. C.

1914. Mencke, J. Bernhard, A.B., M.D., Assistant Surgeon to the Lankenau Hospital; Surgeon to the Out-Patient Department of the Lankenau Hospital. 1816 Spruce St.

1923. Mendelson, Walter, M.D. 639 Church Lane, Germantown.

1914. Merrill, William Jackson, A.B., M.D., Associate Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Orthopedic Surgeon to the Children's Hospital, Germantown Hospital, Children's Seashore House; Consulting Orthopedic Surgeon to the Howard Hospital and Glen Mills School. 2017 Spruce St.

*1894. Miller, D. J. Milton, M.D., Associate Physician to the Children's Hospital, Philadelphia; Pediatrist to the Bamberger Home for Invalid Children, Longport, N. J. N. W. Cor. Pacific and California Aves., Atlantic City, N. J.

1922. Miller, Edwin B., M.D., Ophthalmologist to Stetson and Northwestern General Hospitals. 2008 Walnut St.

1921. Miller, T. Grier, A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Chief, Gastro-intestinal Clinic; Assistant Physician, University Hospital; Consultant, Friends'

ELECTED

Hospital and Shriners' Hospitals for Crippled Children. 110 S. Twentieth St.

1881. Mills, Charles K., M.D., LL.D., Emeritus Professor of Neurology in University of Pennsylvania; Neurologist to Philadelphia General Hospital; Consulting Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 2121 DeLancey St.

*1917. Mitchell, A. Graeme, M.D., Professor of Pediatrics, College of Medicine, University of Cincinnati; Director of Pediatric and Contagious Services, Cincinnati General Hospital; Chief of Staff of Children's Hospital, Cincinnati. University of Cincinnati.

1904. Mitchell. Charles F., M.D., Surgeon to the Pennsylvania, Bryn Mawr, and Germantown Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 2003 Pine St.

1921. Mohler, Henry K., P.D., M.D., Associate in Medicine, Jefferson Medical College; Medical Director, Jefferson Hospital. 319 S. Sixteenth St.

*1908. Montgomery, Charles M., A.B., M.D. Oteen, N. C.

1928. Moon, Virgil Holland, A.B., M.D., M.Sc. Jefferson Medical College.

1923. Moore, William F., M.D., Assistant, Bronchoscopic Clinic, Jefferson Hospital; Bronchoscopist to Philadelphia General Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Laryngologist, Children's Hospital, Out-Patient Department; Laryngologist to Tuberculosis Department, Philadelphia General Hospital. 255 S. Sixteenth St.

1924. Moorhead, Stirling W., A.B., M.D., Associate in Urology, School of Medicine, University of Pennsylvania; Assistant Surgeon, Department of Genito-urinary Surgery and in Urological Dispensary, University Hospital; Urologist, Howard Hospital. 1523 Pine St.

1918. Morgan, Arthur C., M.D., Professor of Applied Therapeutics, Medical Department, Temple University; Visiting Physician to Tuberculosis Department, Philadelphia General Hospital; Consulting Physician to the Eastern State Penitentiary and to the Frankford Hospital. 1930 Chestnut St.

1886. Morris, Caspar, M.D. Haverford, Pa.

1893. Morris, Elliston J., M.D., Consulting Physician to the Episcopal Hospital. 128 S. Eighteenth St.

‡1883. Morris, Henry, M.D., Emeritus Professor of Anatomy in the Woman's Medical College of Pennsylvania; Consulting Physician to St. Joseph's Hospital. 2310 Pine St.

ELECTED

1897. Morton, Samuel W., M.D. 2049 Chestnut St.

1929. Mudd, Stuart, B.S., M.A., M.D., Associate in Pathology, Henry Phipps Institute; Assistant Professor of Experimental Pathology, University of Pennsylvania. Villa Nova, Pa.

1905. Müller, George P., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University and Misericordia Hospitals. 1930 Spruce St.

*1915. Musser, John H., Jr., B.S., M.D., Professor of Medicine and Head of Department, School of Medicine, Tulane University of Louisiana. 1527 Seventh St., New Orleans, La.

1905. Mutschler, Louis H., M.D., Surgeon to the Episcopal Hospital; Associate Surgeon to the Orthopædic Hospital. 1625 Spruce Street.

‡1896. Myers, T. D., M.D. 831 University Ave., Palto Alto, Calif.

1902. Nassau, Charles F., M.D., LL.D., Associate Professor of Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital; Chief Surgeon to the Frankford Hospital; Surgeon to Girard College. 1710 Locust St.

1886. Neff, Joseph S., A.M., M.D., LL.D., D.P.H., Narberth, Pa.

1887. Neilson, Thomas Rundle, A.M., M.D., Surgeon Emeritus to the Episcopal Hospital; Consulting Surgeon to St. Christopher's Hospital for Children; Emeritus Professor of Genito-urinary Surgery in the University of Pennsylvania. 1937 Chestnut St.

1905. Newcomet, William S., M.D., Physician in Charge of Radiological Department, Jefferson, Presbyterian and Oncologic Hospitals. 3501 Baring St.

1905. Newlin, Arthur, B.S., M.D., Physician to the Pennsylvania Hospital. 1804 Pine St.

1899. Nicholson, William Rufus, A.B., M.D., Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Attending Gynecologist and Attending Obstetrician to the Methodist Episcopal Hospital; Attending Obstetrician to the Presbyterian Hospital. 2023 Spruce St.

1889. Noble, Charles P., M.D., Sc.D. (Hon.), Formerly Surgeon-in-Chief, Kensington Hospital for Women; Formerly Clinical Professor of Gynecology, Woman's Medical College. Radnor, Pa.

1905. Norris, Charles C., M.D., Director of the Department and Professor of Obstetrics and Gynecology in the School of Medicine, and Professor of Gynecology in the Graduate School of Medicine, University of Pennsylvania; Gynecologist and Obstetrician to the University and Radiologic Department,

ELECTED

Philadelphia General Hospital; Consultant Gynecologist and Obstetrician to Henry Phipps Institute; Consultant Obstetrician to Maternity Hospital; Gynecologist to the Children's Hospital. 133 S. Thirty-sixth St.

1905. Norris, George William, A.B., M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician-in-Chief, Medical Service "A", Pennsylvania Hospital; Attending Specialist (Heart and Lungs), U. S. Public Health Service (Veterans' Bureau). 321 S. Eleventh St.

*1901. Norris, Henry, M.D., Surgeon to the Rutherford Hospital. Waverly Mills, S. C.

1892. Norris, Richard C., M.D., Professor of Obstetrics in the Graduate School of Medicine, University of Pennsylvania; Obstetrician in Charge of the Preston Retreat; Visiting Obstetrician to the Philadelphia General Hospital; Gynecologist to the Methodist Episcopal Hospital, and Consulting Obstetrician and Attending Gynecologist to the Southeastern Dispensary and Hospital. 500 N. Twentieth St.

1913. O'Neal, Alexander H., A.B., A.M., M.D., Physician to the Cathcart and Richardson Homes, Devon; Anesthetizer to the Bryn Mawr Hospital. St. Davids, Pa.

1924. Opie, Eugene L., A.B., M.D., Professor of Pathology and Director of the Department of Pathology in the School of Medicine, University of Pennsylvania; Director of Laboratories, Henry Phipps Institute. 2203 St. James Place.

1903. Ostheimer, Maurice, A.B., M.D., Whitford, Pa.

1913. Outerbridge, George W., A.B., M.D., Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Assistant Gynecologist to the Methodist Hospital; Gynecologist to the Abington Memorial Hospital. 1927 Spruce St.

1915. Owen, Hubley R., M.D., Professor of Clinical Surgery, Woman's Medical College; Surgeon, Philadelphia General Hospital; Assistant Surgeon, Orthopedic Hospital; Chief Surgeon, Bureaus of Police and Fire, Philadelphia. 319 S. Sixteenth St.

1897. Packard, Francis R., M.D., Chief of the Laryngological Service, Pennsylvania Hospital; Consulting Laryngologist Bryn Mawr Hospital; Otologist to the Children's Hospital of Philadelphia; Editor, *Annals of Medical History*. 304 S. Nineteenth St.

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1898. Page, Henry F., M.D., Assistant Physician to the Lankenau Hospital and Physician to the Medical Dispensary of the same; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania. 315 S. Sixteenth St.

1906. Pancoast, Henry K., M.D., Professor of Roentgenology in the School of Medicine, University of Pennsylvania and Roentgenologist to the University Hospital. Haverford, Pa.

1909. Parish, Benjamin D., B.S., M.D., Associate Professor in Otology, Graduate School of Medicine, University of Pennsylvania; Aurist and Laryngologist to St. Agnes' and Chestnut Hill Hospitals. 1927 Spruce St.

1899. Parke, William E., M.D., Consulting Obstetrician to the Episcopal Hospital; Associate Surgeon to the Kensington Hospital for Women; Gynecologist to the Frankford Hospital. 1534 N. Fifteenth St.

1925. Patten, Clarence A., M.D., Assistant Professor of Neurology, Graduate School of Medicine, University of Pennsylvania; Consulting Neurologist, Shriner's Hospital for Crippled Children and Delaware County Hospital; Neurologist, Delaware General Hospital. 2037 DeLancey St.

1910. Patterson, Ross Vernet, M.D., Dean and Associate Professor of Medicine, Jefferson Medical College; Physician to the Philadelphia General Hospital; Physician to the Protestant Episcopal Hospital; Assistant Physician to the Jefferson Hospital. 2126 Spruce St.

*1926. Paul, John Rodman, A.B., M.D., Assistant Professor of Medicine, School of Medicine, Yale University; Associate Physician, New Haven Hospital and Dispensary. 146 Everitt St., New Haven, Conn.

1922. Pelouze, P. S., M.D., Associate in Urology, School of Medicine, University of Pennsylvania; Surgeon-in-Charge, Urological Dispensary, University Hospital. 1737 Chestnut St.

1909. Pemberton, Ralph, M.S., M.D., Visiting Physician and Director of the Department of Metabolic Diseases, Presbyterian Hospital; Associate Professor of Medicine, Graduate School, University of Pennsylvania. 2031 Locust St.

1914. Pepper, O. H. Perry, B.S., M.D., Professor of Clinical Medicine, School of Medicine, University of Pennsylvania. University Hospital, Thirty-sixth and Spruce Sts.

†1902. Pepper, William, A.B., M.D., Dean of the School of Medicine, University of Pennsylvania; Member of the Council on Medical Education and Hospitals of the American Medical Association. University of Pennsylvania.

ELECTED

1916. Percival, Milton Fraser, M.D. 2332 S. Broad St.

1917. Peter, Luther C., A.M., M.D., Professor of Diseases of the Eye, Temple Medical School; Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania. 1930 Chestnut St.

1912. Petty, Orlando H., B.S., A.M., M.D., Professor of Diseases of Metabolism, Graduate School of Medicine, University of Pennsylvania; Chief of the Department of Diseases of Metabolism, Hospitals of Graduate School of Medicine, University of Pennsylvania; Chief of Department of Metabolism, Philadelphia General Hospital. 1803 Pine St.

1905. Pfahler, George E., M.D., D.O.R.E. (Camb.), Professor of Radiology and Vice-Dean, Department of Radiology, Graduate School of Medicine, University of Pennsylvania; Director of Radiological Department, Misericordia Hospital. 1321 Spruce St.

1915. Pfeiffer, Damon B., A.B., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon, Methodist and Abington Memorial Hospitals; Assistant Surgeon, Presbyterian and Lankenau Hospitals. 1822 Pine St.

1907. Pfromm, George W., Ph.G., M.D., Assistant Physician to the American Stomach Hospital; Consulting Physician to the German Protestant Home for the Aged. 269 S. Nineteenth St.

1907. Phillips, Horace, M.D., Assistant Surgeon, U. S. Public Health Service; Examining Physician, Office of the District Attorney. 905 Land Title Building.

1911. Piersol, George Morris, B.S., M.D., Professor of Medicine and Vice-Dean for Medicine, Graduate School of Medicine, University of Pennsylvania; Physician to the Philadelphia General, Presbyterian and Methodist Episcopal Hospitals. 1913 Spruce St.

1917. Piper, Edmund Brown, B.S., M.D., Professor of Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician to the University Hospital; Assistant Obstetrician and Gynecologist to the Philadelphia General Hospital. 2031 Locust St.

1905. Pitfield, Robert L., M.D., Pathologist to the Germantown Hospital; Bacteriologist to the Chestnut Hill Hospital for Lung Diseases. 5211 Wayne Ave.

1922. Pleasants, Henry, Jr., A.B., M.D., Assistant Visiting Physician, Chester County Hospital, West Chester, Pa.; Assistant in Neurological Clinic, Orthopedic Hospital. West Chester, Pa.

ELECTED

1896. Posey, William Campbell, M.D., Consulting Ophthalmic Surgeon to Wills, Howard, Chestnut Hill and Abington Hospitals. Radnor, Pa.

1899. Potts, Charles S., M.D., Professor of Neurology, Graduate School of Medicine, University of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consulting Neurologist, Lankenau Hospital; Consulting Neurologist, Hospital for the Insane, Atlantic County, New Jersey. 2018 Chestnut St.

*1907. Price, George E., M.D. Stimson Building, Seattle, Wash.

*1920. Quicksall, William E., M.D. E. 216 Fifteenth Ave., North, St. Petersburg, Fla.

1908. Radcliffe, McCluney, A.M. (Lafayette), M.D., LL.D., Consulting Ophthalmologist, Presbyterian Hospital; Attending Surgeon to the Wills Hospital. 1930 Chestnut St.

1913. Randall, Alexander, A.M., M.D., Associate Professor of Surgery in charge of the Department of Urology, School of Medicine, University of Pennsylvania. 1323 Medical Arts Building.

1887. Randall, B. Alex., M.A., M.D., Ph.D., Emeritus Professor of Otology in the School of Medicine, University of Pennsylvania; Ear Surgeon to the Children's Hospital; Consulting Aurist to the Pennsylvania Institution for the Dear and Dumb and to Memorial Hospital, Roxborough. 2320 DeLancey St.

1926. Ravdin, I. S., B.S., M.D., J. William White Assistant Professor of Surgical Research in the School of Medicine and Assistant Professor of Research Surgery in the Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, University Hospital. 4623 Larchwood Ave.

*1904. Ravenel, Mazyck P., M.D., Professor of Preventive Medicine and Bacteriology and Director of the Public Health Laboratory at the University of Missouri. 203 Westmount Ave., Columbia, Mo.

1928. Reese, Warren S., M.D., Assistant Ophthalmologist, Pennsylvania Hospital; Assistant Surgeon, Wills Hospital; Associate Ophthalmologist, Delaware County Hospital; Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania. 230 S. Twenty-first St.

1925. Reeves, Rufus S., B.S., M.D. 2227 Spruce St.

1920. Rehfuss, Martin E., M.D. N. E. Cor. Sixteenth and Spruce Streets.

ELECTED

1921. Reiff, E. Paul, A.B., M.D., Member of Medical Staff, Methodist Episcopal Hospital. 5051 Chestnut St.

1919. Reimann, Stanley P., M.D., Director of the Research Institute, Lankenau Hospital; Assistant Professor of Experimental Pathology, Graduate School of Medicine, University of Pennsylvania. 516 Arbutus St., Germantown.

1929. de Rényi, George S., M.D., Associate Professor of Anatomy, University of Pennsylvania. 216 S. Forty-sixth St.

1923. Repplier, Sidney, J., M.D., Medical Director, Curtis Hospital, Curtis Publishing Company. Chestnut Hill, Phila.

1906. Rhein, Robert D., M.D., Chief Physician to the Clinic of the American Hospital for Diseases of the Stomach; Physician to the Philadelphia Home for Incurables; Examining Physician to the White Haven Sanatorium. S. W. Cor. Fifteenth and Pine Sts.

*1910. Rhoads, Samuel, M.D. Altadena, Calif.

1919. Richardson, Russell, A.M., M.D., Director of the Laboratory, Methodist Episcopal Hospital; Pathologist to Abington Memorial Hospital and the Associated Medical Clinics; Instructor in Medicine, University of Pennsylvania. 320 S. Sixteenth St.

1919. Ridpath, Robert F., M.D., Professor of Rhino-laryngology, Temple University; Associate Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania; Laryngologist, Samaritan and Jewish Hospitals. 1737 Chestnut St.

1898. Riesman, David, M.D., Sc.D., Professor of Clinical Medicine, School of Medicine, University of Pennsylvania; Visiting Physician to the Philadelphia General and University Hospitals; Consulting Physician to the Jewish and Woman's Hospitals. 1520 Spruce St.

1895. Ring, G. Oram, A.M., M.D., Consulting Ophthalmologist to the Episcopal Hospital; Ophthalmologist to the Widener Memorial Home for Crippled Children; Consulting Ophthalmologist to the American Oncologic Hospital. N. E. Cor. Seventeenth and Walnut Sts.

1899. Roberts, Walter, M.D., Professor of Otology in the Graduate School of Medicine, University of Pennsylvania; Otologist to the Methodist Episcopal Hospital; Laryngologist to the Philadelphia General Hospital. 1921 Spruce St.

1903. Robertson, William Egbert, M.D., Professor of Theory and Practice of Medicine and of Clinical Medicine in Temple University; Physician to the Samaritan and Garretson Hospitals. 327 S. Seventeenth St.

ELECTED

1903. Robinson, William Duffield, Ph.G., M.D. 2012 Mount Vernon St.

1912. Rodman, John Stewart, M.D., Professor of Surgery, Woman's Medical College; Surgeon-in-Chief, Woman's College Hospital; Attending Surgeon, Bryn Mawr Hospital; Assistant Surgeon to the Presbyterian Hospital. 1310 Medical Arts Building.

1928. Rose, Edward, M.D., Instructor in Medicine, University of Pennsylvania; Medical Registrar, University Hospital. 1726 Pine St.

1909. Rosenberger, Randle C., M.D., Professor of Preventive Medicine and Bacteriology in the Jefferson Medical College. 1001 Walnut St.

*1907. Royer, B. Franklin, M.D. 370 Seventh Ave., New York City.

†1905. Rugh, James Torrance, A.B., M.D., Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Orthopedic Surgeon to the Jefferson Medical College; Orthopedic Surgeon to the Methodist and the Philadelphia General Hospitals. 911 Medical Arts Building.

1929. Ryan, William John, M.D. Medical Arts Building.

‡1900. Sajous, Charles E. de M., M.D., LL.D., Sc.D., Officer of the Legion of Honor of France and of the Order of Leopold of Belgium; Professor of Applied Endocrinology, Graduate School of Medicine, University of Pennsylvania; Emeritus Professor of Therapeutics in Temple University Medical School. 2043 Walnut St.

1905. Sartain, Paul J., A.M., M.D. 2006 Walnut St.

1908. Sautter, Albert C., M.D., Assistant in the Eye Dispensary of the Lankenau Hospital. 5909 Greene St., Germantown.

1927. Saxon, Gordon J., M.D. 1506 Medical Arts Building.

1906. Saylor, Edwin S., M.D., Consulting Ophthalmologist, American Hospital for Diseases of the Stomach. 1737 Chestnut St.

1920. Scarlett, Hunter W., M.D., Associate in Ophthalmology in the Graduate School of Medicine, and Medical Examiner in the Department of Physical Education, University of Pennsylvania. 230 S. Twenty-first St.

1917. Schaeffer, Jacob Parsons, A.M., M.D., Ph.D., Sc.D., Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College. 4634 Spruce St.

1899. Schamberg, Jay F., M.D., Professor of Dermatology and Syphilology, Graduate School of Medicine, University of

ELECTED

Pennsylvania; Director, Research Institute of Cutaneous Medicine. 1402 Spruce St.

1929. Scheffey, Lewis C., M.D. 267 S. Nineteenth St.

1929. Schenck, Harry P., B.S., M.D., Research Fellow in Allergy and Assistant Instructor in Otolaryngology, University of Pennsylvania; Lecturer and Instructor in Pathology, Evans Institute; Assistant Otolaryngologist, Children's Hospital. 1912 Spruce St.

1917. Schnabel, Truman Gross, A.B. (Lehigh), M.D., Associate in Medicine, University of Pennsylvania; Physician, Philadelphia General and Howard Hospitals, and Medical Dispensary University Hospital. 1704 Pine St.

1917. Schoff, Charles H., M.D. Media, Pa.

1928. Schofield, Frederick S., A.B., M.D., Associate in Urology, Medical School, University of Pennsylvania; Chief of Urological Dispensary, University Hospital; Urologist, Orthopedic Hospital; Assistant Urologist, Chestnut Hill Hospital. 822 Medical Arts Building.

1921. Schumann, Edward Armin, A.B., M.D., Assistant Professor of Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician and Gynecologist, Philadelphia General Hospital; Gynecologist, Frankford Hospital; Lecturer on Obstetrics, Jefferson Medical College; Consulting Gynecologist, Rush Hospital. 1814 Spruce St.

1887. de Schweinitz, George Edmund, A.M., M.D., LL.D., L.H.D., Sc.D., Professor of Ophthalmology in the Graduate School of Medicine, University of Pennsylvania; Consulting Ophthalmic Surgeon to the Orthopedic, Philadelphia General and Bryn Mawr Hospitals. 1705 Walnut St.

*1913. de Schweinitz, George Lord, B.S., M.D., Assistant in the Department of Ophthalmology, St. Luke's Hospital, Bethlehem, Pa. 85 East Broad St., Bethlehem, Pa.

1910. Schwenk, Peter N. K., M.A., M.D., Attending Surgeon to Eye Department of the Pennsylvania Hospital; Attending Surgeon to the Wills Hospital. 1417 N. Broad St.

1917. Service, Charles A., M.D. Bala, Pa.

1924. Shallow, Thomas A., M.D., Assistant Surgeon, Jefferson Hospital; Demonstrator of Clinical Surgery, Jefferson Medical College; Surgeon to the Philadelphia General Hospital. 3942 Chestnut St.

1908. Shannon, Charles E. G., A.B., M.D., Instructor in Ophthalmology in the Jefferson Medical College; Assistant in the Ophthalmological Clinic at the Jefferson Medical College

ELECTED

Hospital; Ophthalmologist to the Seybert Institution. N. E. Corner Seventeenth and Walnut Sts.

1928. Sharpe, John Semple, M.D. Haverford, Pa.

1928. Sharpless, Frederick Cope, A.B., M.D., Attending Physician, Bryn Mawr, Hospital. Rosemont, Pa.

1897. Sharpless, William T., M.D., Physician to the Chester County Hospital. West Chester, Pa.

1906. Shields, William G., M.D., Dermatologist to Germantown Hospital; Chief of Dermatological Clinic and Assistant Physician to the Jewish Hospital. 414 School Lane, Germantown.

*1908. Shoemaker, Harlan, A.B., M.D., Chief Surgeon to Los Angeles County Hospital; Chief of the Surgical Staff of the Methodist Hospital and of the Hospital of the Good Samaritan. 1930 Wilshire Building, Los Angeles, Calif.

†1893 Shoemaker, Harvey, M.D., Visiting Physician to the Sheltering Arms; Consulting Physician to the Southern Home for Destitute Children; Assistant Physician to the Lankenau Hospital; Physician to the Out-Patient Department of the Lankenau Hospital. 1727 Spruce St.

†1896. Shoemaker, William T., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Ophthalmology in the Woman's Medical College of Pennsylvania; Ophthalmic Surgeon to Lankenau, Germantown and Pennsylvania Hospitals. 2017 Locust St.

1900. Shumway, Edward Adams, B.S., M.D., Ophthalmic Surgeon to the Lankenau, Children's and Oncologic Hospitals. 1737 Chestnut St.

1903. Sinclair, John Falconer, M.D., Epidemiologist, Presbyterian Hospital; Physician to the Philadelphia Orphan Asylum and to the Presbyterian Orphanage; Physician to the Home of the Merciful Saviour for Crippled Children. 4103 Walnut St.

1907. Sinkler, Francis Wharton, A.B., M.D., Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 1226 Medical Arts Building.

1902. Siter, E. Hollingsworth, M.D., Genito-urinary Surgeon to the Philadelphia General Hospital. 2213 DeLancey St.

1920. Skillern, Ross Hall, M.D., Sc.D., Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 1811 Spruce St.

1928. Skillern, Samuel Ruff, M.D., Assistant Professor in Otolaryngology, Graduate School of Medicine, University of Pennsylvania. 1734 Pine St.

ELECTED

1929. Smith, Austin Thomas, M.D., Clinical Assistant, Department of Laryngology, Jefferson Hospital; Instructor in Laryngology, Jefferson Medical College. 259 S. Seventeenth St.

‡1905. Smith, S. MacCuen, M.D., Professor of Otology in the Jefferson Medical College; Aurist and Laryngologist to the Germantown Hospital; Aurist to the Jewish Hospital; Consulting Aurist to the Memorial Hospital, Roxborough, and to the Oncologic Hospital. 1429 Spruce St.

1927. Smyth, Calvin M., Jr., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Attending Surgeon to the Methodist and Abington Hospitals. 257 S. Twenty-first St.

1919. Smyth, Henry Field, M.D., Assistant Professor of Industrial Hygiene, School of Hygiene, University of Pennsylvania. Wayne, Pa.

1928. Spaeth, Edmund B., M.D., Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology, School of Medicine, Temple University. 1930 Chestnut St.

1908. Speese, John, M.D., Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Children's and Presbyterian Hospitals. 133 S. Thirty-sixth St.

1897. Spiller, William G., M.D., Professor of Neurology in the University of Pennsylvania; Consulting Neurologist to the Philadelphia General Hospital. 4409 Pine St.

1929. Sponsler, Marshall B., M.D. 1934 Spruce St.

1894. Stahl, B. Franklin, B.S., Ph.G., M.D. Haverford, Pa.

1909. Starbuck, J. Clinton, M.D., Physician to the Orphanage, Orphan Society of Philadelphia, at Wallingford, and to the Glen Mills School, Glen Mills, Pa. 42 E. Washington St., Media, Pa.

1927. Starr, Isaac, Jr., B.S., M.D., Assistant Professor of Clinical Pharmacology and Associate in Medicine, School of Medicine, University of Pennsylvania; Acting Physician, University Hospital. Chestnut Hill.

1912. Stauffer, Nathan Pennypacker, D.D.S., M.D., Laryngologist and Otologist to the Presbyterian Hospital; to the Philadelphia General Hospital, Tubercular Department; to the Home for Crippled Children. 1900 Rittenhouse Square.

1910. Stellwagen, Thomas C., Jr., M.D., Chief Clinical Assistant in the Out-Patient Surgical Department of the Jefferson Medical College Hospital. 220 S. Sixteenth St.

ELECTED

1895. Stengel, Alfred, M.D., Sc.D., Professor of Medicine in the University of Pennsylvania; Physician to the University Hospital and the Pennsylvania Hospital. 1728 Spruce St.

1901. Stevens, Arthur A., M.D., Professor of Applied Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Therapeutics and Clinical Medicine in the Woman's Medical College of Pennsylvania; Physician to St. Agnes' Hospital. 314 S. Sixteenth St.

1914. Stewart, Thomas S., B.S. (Univ. of Penna.), M.D. 1532 Pine St.

1925. Stokes, John H., A.B., M.D., Professor of Dermatology and Syphilology, School of Medicine, and Graduate School of Medicine, University of Pennsylvania; Attending Dermatologist, University and Philadelphia General Hospitals; Dermatologist, Hospital of the Graduate School of Medicine. 3800 Chestnut St.

1928. Stokes, Joseph, Jr., A.B., M.D., Associate in Pediatrics, School of Medicine, University of Pennsylvania. 159 W. Coulter St., Germantown.

1898. Stout, George C., M.D., Consulting Laryngologist and Aurist to the Presbyterian Hospital, the Children's Aid Society and the William Penn Charter School. 2015 Walnut St.

1923. Strecker, Edward, A., A.M., M.D., Professor of Nervous and Mental Diseases, Jefferson Medical College; Clinical Professor of Psychiatry and Mental Hygiene, Yale University Medical School; Neurologist, Pennsylvania Hospital; Medical Director of Department for Mental and Nervous Diseases, Pennsylvania Hospital 4401 Market St.

1923. Stroud, William D., B.S., M.D., Physician to the Pennsylvania Hospital and Chief of Out-Patient and Heart Clinics; Associate Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania; Associate in Medicine, School of Medicine, University of Pennsylvania; Physician in Charge of the Children's Heart Hospital, Wynnefield, Pa. 1011 Clinton St.

1923. Strouse, Frederick M., M.D., Assistant Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 1301 Spruce St.

‡1884. Stryker, Samuel S., M.D., Consulting Physician to the Presbyterian Hospital. 3833 Walnut St.

1927. Sturgis, Samuel B., M.D. Ardmore, Pa.

*1900. Swan, John M., M.D., Attending Physician, Park Avenue Hospital. 457 Park Avenue, Rochester, N. Y.

ELECTED

1928. Swartley, William B., M.D , Surgeon to Germantown Dispensary and Hospital and to Chestnut Hill Hospital; Instructor in Anatomy, Jefferson Medical College. 6002 Greene St., Germantown.

1900. Talley, James Ely, A.B., M.D., Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania; Physician to the Presbyterian Hospital. 1811 Spruce St.

1886. Taylor, John Madison, A.B., and A.M. (Princeton), M.D., Professor of Physical Therapeutics and Dietetics, Medical Department, Temple University. 1504 Pine St.

1887. Taylor, William J., M.D., Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to St. Agnes', West Philadelphia Hospital for Women and Woman's Hospitals. 1825 Pine St.

1886. Taylor, William L., M.D. 2223 Tioga St.

†1910. Thomas, Benjamin A., A.B., A.M., M.D., Vice-Dean and Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Genito-urinary Surgeon, Presbyterian Hospital; Consulting Genito-urinary Surgeon, Pennsylvania Railroad and to the County Prison, Philadelphia. 1900 Spruce St.

1928. Thomas, J. Earl, M.D. Drexel Hill, Pa.

1907. Thomas, Thomas Turner, M.D., Associate Professor of Applied Anatomy and Associate in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the University Hospital. 1737 Chestnut Street.

1896. Thorington, James, A.M., M.D., Consulting Ophthalmic Surgeon to the Presbyterian Hospital; Ophthalmologist to the Ellwyn, Pa., Training School for Feeble-minded Children. 2031 Chestnut St.

1927. Thorington, J. Monroe, B.S., A.M., M.D., Instructor in Ophthalmology, University of Pennsylvania; Assistant in Ophthalmology, Presbyterian Hospital. 2031 Chestnut St.

1898. Thornton, Edward Q., M.D., Assistant Professor of Materia Medica in the Jefferson Medical College. 1331 Pine St.

1912. Torrey, Robert G., M.D., Physician to the Philadelphia General Hospital; Associate Professor of Medicine, Graduate School of Medicine, and Associate in Medicine, School of Medicine, University of Pennsylvania. 1716 Locust St.

‡1896. Toulmin, Harry, M.D., Vice-President, Medical Department, Penn Mutual Life Insurance Company. Haverford, Pa.

ELECTED

1908. Tracy, Stephen E., M.D., Gynecologist to the Stetson Hospital; Visiting Surgeon to the Gynecean Hospital. 1737 Chestnut St.

1926. Tucker, Gabriel, M.D., Associate Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, and Associate Bronchoscopic Surgeon, University Hospital, University of Pennsylvania; Associate in Bronchoscopy and Assistant Bronchoscopist, Jefferson Medical College and Hospital; Bronchoscopist, Misericordia and Bryn Mawr Hospitals. Cynwyd, Pa.

*1901. Tucker, Henry, M.D. Bellevue, Md.

†1894. Tunis, Joseph Price, M.D. Chestnut Hill, Philadelphia.

1924. Turner, Charles Root, A.B., D.D.S., M.D., Dean, School of Dentistry, University of Pennsylvania. Merion, Pa.

1923. Turner, Creighton H., M.D., Associate in Medicine, Jefferson Medical College; Visiting Physician, St. Agnes' Hospital. 1731 Pine St.

1929. Tyson, Ralph M., M.D., Associate in Pediatrics, Jefferson Medical College; Pediatrist, Pennsylvania Hospital. 334 S. Twenty-first St.

1907. Ullom, Josephus Tucker, M.A., M.D., Physician to the Chestnut Hill Hospital. Carpenter and Quincy Streets, Germantown.

*1913. Vail, William Penn, B.S., M.S., M.D., Laryngologist to the Pennsylvania Institution for the Instruction of the Blind; Laryngologist to the Department for Tuberculosis of the Philadelphia General Hospital; Assistant Laryngologist and Otologist to the Out-Patient Department of the Pennsylvania Hospital; Assistant Laryngologist to the Children's Hospital. Blairstown, N. J.

1873. Van Harlingen, Arthur, Ph.B. (Yale), M.D., Emeritus Professor of Diseases of the Skin in the Philadelphia Polyclinic. Bryn Mawr, Pa.

1903. Van Pelt, William Turner, M.D. Chestnut Hill, Philadelphia.

1912. Vaux, Norris Wistar, M.D., Clinical Professor of Obstetrics, Jefferson Medical College; Chief of Maternity Service, Philadelphia Lying-in and Pennsylvania Hospitals; Surgeon to the Chestnut Hill Hospital; Surgeon to the Dispensary of the Germantown Hospital. 2031 Locust St.

ELECTED

*1897. Veasey, Clarence A., A.M., M.D., Ophthalmic Surgeon to the Deaconess and to St. Luke's Hospitals. Suite 404, Paulsen Building, Spokane, Wash.

†1883. Vinton, Charles Harrod, A.M., M.D. P. O. Box 464, Atlantic City, N. J.

1903. Wadsworth, William Scott, M.D. 3914 Baltimore Ave.

1927. Wagers, Arthur J., M.D., Assistant Professor of Laryngology Graduate School of Medicine; University of Pennsylvania; Demonstrator of Otology and Laryngology, Jefferson Medical College; Otologist, Joseph Price Hospital. 1429 Spruce St.

1928. Wagoner, George W., M.D., Assistant Professor of Orthopedic Surgery, Graduate School of Medicine, and Associate in Pathology, School of Medicine, University of Pennsylvania; Clinical Surgeon, Orthopedic Hospital; Orthopedic Surgeon, Bryn Mawr Hospital. 2008 Walnut St.

1906. Walker, John K., M.D., Physician to the Children's Hospital of the Mary J. Drexel Home; Physician to the Out-Patient Department of the Pennsylvania Hospital. 1814 Pine St.

1907. Walker, Warren, M.D., Dermatologist to the Episcopal and Bryn Mawr Hospitals. 1819 Chestnut St.

1904. Walsh, Joseph, A.M., M.D., Visiting Physician to and Medical Director of the White Haven Sanatorium. Medical Arts Building.

1895. Watson, Arthur W., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Jewish Hospital; Laryngologist and Aurist to the Mt. Sinai Hospital; Laryngologist to Home for Incurables. 2013 Locust St.

1923. Watson, William R., M.D., Chief Laryngologist, Episcopal and Diagnostic Hospitals; Assistant Chief Laryngologist, Pennsylvania Hospital. 2124 Pine St.

1903. Weber, Charles H., M.D., Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Consulting Physician to the Medical Dispensary, Children's Hospital; Pediatrist, Howard Hospital and to the Municipal Court. 2048 Pine St.

1920. Weidman, Fred. D., M.D., Professor of Dermatological Research, University of Pennsylvania; Assistant Pathologist, Philadelphia Zoölogical Garden; Attending Dermatologist, Philadelphia General Hospital. 20 Tenby Road, Llanerch, Pa.

ELECTED

1906. Weisenburg, Theodore H., M.D., Professor of Neuro-Psychiatry, Graduate School of Medicine, University of Pennsylvania; Neurologist, Philadelphia General Hospital, and Physician to Orthopedic Hospital and Infirmary for Nervous Diseases. 1930 Chestnut St.

1923. Weiss, Edward, M.D., Associate in Medicine and Pathology, Jefferson Medical College; Physician to the Tuberculosis Wards, Philadelphia General Hospital. 1923 Spruce St.

1913. Wells, P. Frailey, A.M., M.D., Ph.D. 754 N. Fortieth St.

1893. Westcott, Thompson S., M.D., Consulting Pediatrist to the Methodist Episcopal Hospital; Consulting Pediatrist, Haddock Memorial Home. 1720 Pine St.

1921. Whitaker, William, M.D. 5448 Germantown Ave.

1901. White, Courtland Y., M.D., Director of the Pathological Laboratories of the Episcopal Hospital; Pathologist to the Children's Hospital and to the Kensington Hospital for Women; Chief Bacteriologist to the Bureau of Health, Department of Health and Charities, Philadelphia; Associate Professor of Bacteriology in the Graduate School of Medicine, University of Pennsylvania. 6611 N. Tenth St.

*1905. Whiteway, Harold M., M.D. 2356 W. Twenty-first St., Los Angeles, Calif.

1898. Whiting, Albert D., M.D., Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Surgeon, Lankenau Hospital; Surgeon, Germantown Hospital. 333 S. Eighteenth St.

1925. Widmann, Bernard P., M.D., Assistant Professor of Radiology, Graduate School of Medicine, University of Pennsylvania; Chief of the Radiological Department of the Philadelphia General Hospital. 250 S. Eighteenth St.

1914. Willard, de Forest P., B.S. (Univ. of Penna.), M.D., Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Orthopedic Surgeon to the Graduate and Delaware Hospitals and Consultant to the Shriners' Hospital for Crippled Children. 1729 Spruce St.

1907. Williams, Carl, B.S., M.D., Ophthalmic Surgeon to the Germantown Hospital; Instructor in Ophthalmology in the University of Pennsylvania; Ophthalmic Surgeon to the Pennsylvania Institution for the Deaf and Dumb. School Lane and Greene Sts., Germantown.

1924. Williams, Horace James, M.D., Instructor in Otolaryngology, School of Medicine, University of Pennsylvania. 5908 Greene St., Germantown.

ELECTED

1920. Williams, Philip F., Ph.B., M.D., Assistant Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Associate in Obstetrics, School of Medicine, University of Pennsylvania; Gynecologist and Obstetrician to Philadelphia and Jewish Hospitals; Obstetrician, Abington Memorial Hospital. 2206 Locust St.

1927. Williamson, Ernest G., M.D., Surgeon, Children's Hospital; Assistant House Surgeon, Pennsylvania Hospital; Assistant Surgeon, Presbyterian and Jefferson (Dispensary) Hospitals. 6353 Woodbine Ave.

1916. Wilmer, Harry B., M.D., Assistant Professor of Clinical Allergy in the Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Germantown Hospital; Associate Physician, Presbyterian Hospital; Director of the Allergic Clinic, Germantown and Presbyterian Hospitals. 138 W. Walnut Lane, Germantown.

1921. Wilson, George, M.D., Assistant Professor of Neurology, School of Medicine, University of Pennsylvania; Clinical Professor of Neurology, Women's Medical College of Pennsylvania; Neurologist, Philadelphia General, Episcopal and Abington Memorial Hospitals; Assistant Neurologist, University Hospital. 133 S. Thirty-sixth St.

1874. Wilson, James Cornelius, A.M. (Princeton), M.D., Emeritus Professor of the Practice of Medicine and of Clinical Medicine in the Jefferson Medical College; Physician-in-Chief (Emeritus) to the Lankenau Hospital; Emeritus Physician to the Pennsylvania Hospital; Consulting Physician to the Bryn Mawr Hospital. 1509 Walnut St.

1902. Wilson, Samuel M., M.D. 1930 Chestnut St.

1897. Wilson, W. Reynolds, M.D. Villa Nova, Pa.

1904. Wister, James W., M.D., Physician to the Out-Patient Department of the Germantown Hospital. 5430 Germantown Ave.

*1901. Witmer, A. Ferree, M.D. 21 North Grand Ave., Baldwin, N. Y.

1918. Wolferth, Charles Christian, A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Director of the Clinic, Robinette Foundation, University Hospital; Consulting Cardiologist, Jewish Hospital. S. E. Cor. Thirty-sixth and Spruce Sts.

1893. Wood, Alfred C., M.D., Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, the Philadelphia General, St. Timothy's and the Howard Hospitals. 2035 Walnut St.

ELECTED

1900. Wood, George, B., M.D., Laryngologist and Otologist, Orthopedic and Howard Hospitals; Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. N. E. Cor. Twentieth and Chestnut Sts.

1903. Wood, Horatio C., Jr., M.D., Professor of Pharmacology and Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Philadelphia College of Pharmacy and Science. 319 S. Forty-first St.

*1911. Woods, Andrew H., A.B., M.D., Professor of Psychiatry, College of Medicine, and Director of the Psychopathic Hospital, University of Iowa. 621 Summit St., Iowa City, Iowa.

†1897. Woodward, George, M.D. W. Willow Grove Ave., Chestnut Hill, Philadelphia.

1903. Worden, Charles B., A.M., M.D. Princeton, N. J.

1928. Wright, Carroll S., B.Sc., M.D., Associate Professor of Dermatology-Syphilology, Graduate School of Medicine, University of Pennsylvania; Attending Dermatologist, Philadelphia General Hospital. 1402 Spruce St.

1894. Zentmayer, William, M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Consulting Surgeon to the Wills Hospital; Consulting Ophthalmologist to the Glen Mills School and to St. Mary's Hospital. 1930 Chestnut St.

1887. Ziegler, Walter M.L., A.M., M.D. 1418 N. Seventeenth St.

1895. Zimmerman, Mason W., M.D., Consulting Ophthalmic Surgeon to the Germantown Hospital. 1518 Waverly St.

ASSOCIATE FELLOWS

(Limited to Fifty, of whom Twenty may be Foreigners)

American

ELECTED

1909. Billings, Frank, M.D., 1550 North State Parkway, Chicago, Illinois.

‡1880. Carrow, Flemming, M.D., 823 David Whitney Building, Detroit, Mich.

1893. Councilman, William T., M.D., Harvard Medical College, Boston, Massachusetts.

1909. Crile, George W., M.D., 1021 Prospect Avenue, S. E., Cleveland, Ohio.

1909. Dana, Charles Loomis, M.D., 53 West Fifty-third Street, New York City, New York.

‡1892. Emmet, Thomas Addis, M.D., 91 Madison Avenue, New York City, New York.

1916. Estes, William Lawrence, M.D., South Bethlehem, Pa.

1912. McCaw, Brig.-Gen. Walter D., M.D., Assistant Surgeon-General, U. S. A., retired, Woodstock, Ulster Co., N. Y.

1906. Mayo, William J., M.D., Rochester, Minnesota.

1917. Miner, Charles H., M.D., Wilkes-Barre, Pa.

1906. Pilcher, Lewis Stephen, M.D., 489 Washington Avenue, Brooklyn, New York.

‡1906. Shattuck, Frederick C., M.D., 135 Marlborough Street, Boston, Massachusetts.

1892. Welch, William H., M.D., Johns Hopkins Hospital, Baltimore, Maryland.

Foreign

ELECTED

1928. Archibald, Edward, M.D., McGill University, Montreal, Canada.

1924. Hopkins, Sir F. Gowland, M.D., Biochemical Department, University of Cambridge, Cambridge, England.

1909. Macallum, Archibald B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., Department of Biochemistry, McGill University, Montreal, Canada.

1922. McCarrison, Colonel Robert, M.D., C.I.E., D.Sc. LL.D., F.R.C.P. (London), Honorary Physician to the King. Pasteur Institute, Coonoor, S. India.

1924. Macleod, John James R., M.D., M.B., D.Sc. (Hon.), LL.D., F.R.S., 43 Nanton Ave., Toronto, Canada.

1906. Myles, Sir Thomas, M.D., 33 Merion Square, W. Dublin, Ireland.

1885. Rendu, Jean, M.D., Lyons, France.

1928. Rolleston, Sir Humphry, Bart., Q.C.V.O., K.C.B., M.D., D.C.L. (Durh.), LL.D., D.G.C., "Southfield," Trumpington Road, Cambridge, England.

1908. Ross, Col. Sir Ronald, K.C.B., K.C.M.G., F.R.S., M.D., D.Sc., LL.D., Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S. W. 15, England.

NECROLOGICAL LIST

FELLOWS

THOMAS ADDIS EMMET, M.D.	March	1, 1919
FLEMMING CARROW, M.D.	June	23, 1928
FREDERICK C. SHATTUCK	January	11, 1929
HENRY TOULMIN, M.D.	February	8, 1929
HENRY MORRIS, M.D.	February	22, 1929
THOMAS H. FENTON, M.D.	February	23, 1929
LEWIS BRINTON, M.D.	March	13, 1929
CHARLES E. DEM. SAJOUS, M.D.	April	27, 1929
GEORGE FALES BAKER, M.D.	June	3, 1929
PAUL A. LEWIS, M.D.	June	30, 1929
S. McCUEN SMITH, M.D.	September	14, 1929
SAMUEL S. STRYKER, M.D.	October	25, 1929

LIST OF PRIZES AND LECTURES

THE WILLIAM F. JENKS MEMORIAL PRIZE

(Triennial)

1889	John Strahan, M.D.	Belfast (Ireland).
1895	Abram Brothers, M.D.	New York.

NOTE.—June 12, 1900, the William F. Jenks Memorial Prize Fund was transferred to the Library as the "William F. Jenks Memorial Library Fund."

ALVARENGA PRIZE OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

(Annual)

1890	R. W. Philip, M.D.	Edinburgh (Scotland).
1891	L. Duncan Bulkley, M.D.	New York.
1892	R. H. L. Bibb, M.D.	Saltillo.
1894	G. E. de Schweinitz, M.D.	Philadelphia.
1895	Guy Hinsdale, M.D.	Philadelphia.
1897	Joseph Collins, M.D.	New York.
1898	S. A. Knopf, M.D.	New York.
1898	Robert Randolph, M.D.	Baltimore.
1900	David de Beck, M.D.	Cincinnati.
1901	George W. Crile, M.D.	Cleveland.
1903	William S. Carter, M.D.	Galveston.
1905	D. Chalmers Watson, M.D.	Edinburgh (Scotland).
1907	William Louis Chapman, M.D.	Providence.
1908	William T. Shoemaker, M.D.	Philadelphia.
1910	M. Katzenstein, M.D.	Berlin (Germany).
1911	Francis D. Patterson, M.D.	Philadelphia.
1914	H. B. Sheffield, M.D.	New York.
1915	J. E. Sweet, M.D.	Philadelphia.
1917	Wilburt C. Davison, M.D.	Baltimore.
1921	John W. Churchman, M.D.	New York.
1923	Edward P. Heller, M.D.	Kansas City, Mo.
1924	Gordon Cameron, M.B., B.S.	Victoria, Australia.
1925	Raphael Isaacs, M.D.	Boston.
1926	P. S. Pelouze, M.D. and Frederick S. Schofield, M.D.	Philadelphia.
1927	Emil Bogen, M.D.	Cincinnati, Ohio.
1928	J. Rodman Paul, M.D. and William U. McClenahan	Philadelphia.
1929	George M. Dorrance, M.D.	Philadelphia.

NATHAN LEWIS HATFIELD PRIZE FOR ORIGINAL RESEARCH IN MEDICINE

(Triennial)

1901	Henry F. Harris, M.D.	Atlanta.
1909	Martin Henry Fischer, M.D.	Oakland.
1917	A. B. Macallum, M.D., F.R.S.	Toronto.
1919	Harvey Cushing, M.D.	Boston.
1921	William R. Nicholson, M.D.	Philadelphia.
1922	Sir Thomas Lewis, C.B.E., M.D., F.R.S.	London (Eng.).
1923	Frederick Grant Banting, M.D.,	Toronto.
1924	George J. Heuer, M.D.	Cincinnati.
1926	Knud Faber, M.D.	Copenhagen.
1928	John James R. Macleod	Toronto, Can.
1929	Simon Flexner, M.D.	New York.

NOTE.—November 29, 1913, by Supplemental Deed of Trust, the title of this Fund was changed to "Nathan Lewis Hatfield Prize and Lectureship."

WEIR MITCHELL LECTURES

Jan. 17, 1911	Arthur R. Cushny, M.D.	London.
Mar. 30, 1911	Edmund B. Wilson, Ph.D., LL.D.	New York.
May 16, 1911	Svante Arrhenius	Stockholm.
Nov. 3, 1911	William T. Porter, M.D.	Boston.
Mar. 29, 1912	William H. Howell, M.D.	Baltimore.
Oct. 21, 1912	G. H. F. Nuttall, F.R.S., M.D.	Cambridge (Eng.).
April 4, 1913	H. P. Armsby, Ph.D., LL.D.	Pennsylvania.
Feb. 25, 1914	Harvey Cushing, M.D.	Boston.

PUBLIC LECTURES

Feb. 16, 1910	S. Weir Mitchell, M.D.	Philadelphia.
Nov. 17, 1910	Simon Flexner, M.D.	New York.
Dec. 15, 1910	William H. Welch, M.D.	Baltimore.
April 18, 1911	James G. Mumford, M.D.	Clifton Springs, N.Y.
Nov. 20, 1911	Talcott Williams, A.M., LL.D., Litt.D.	Philadelphia.
April 29, 1912	Owen Wister, A.M., LL.D.	Philadelphia.
Feb. 17, 1913	John K. Mitchell, M.D.	Philadelphia.
Feb. 15, 1916	Daniel J. McCarthy, M.D., and Walter Estell Lee, M.D.	Philadelphia.
April 15, 1916	Surgeon A. M. Fauntleroy	U. S. Navy.

MARY SCOTT NEWBOLD LECTURES

Mar. 29, 1917	A. T. McCormack, M.D.	Bowling Green, Ky.
April 4, 1919	Col. Thomas W. Salmon, M.C.,	U. S. Army.
Feb. 6, 1920	Alonzo E. Taylor, M.D.	Philadelphia.
Feb. 4, 1921	Maj.-Gen. Merritte W. Ireland	Washington.
April 20, 1921	Prof. William Romaine Newbold,	Philadelphia.
Nov. 11, 1921	Robert McCarrison, M.D., D.Sc., LL.D.	Oxford (Eng.).
Feb. 1, 1922	Hans Zinsser, M.D.	New York.
April 5, 1922	G. Canby Robinson, M.D.	Baltimore.
Dec. 6, 1922	Donald C. Balfour, M.D.	Rochester, Minn.
Mar. 7, 1923	J. J. R. Macleod, M.D.	Toronto.
April 4, 1923	Prof. Leon Asher, M.D.	Berne (Switzerl'd).
Mar. 5, 1924	Prof. A. Biedl	Prague (Czecho-Slovakia).
April 15, 1924	J. G. FitzGerald, M.D.	Toronto.
Oct. 31, 1924	John I. Hunter, M.D., and N. D. Royle, M.D.	Sydney (Australia).
Dec. 4, 1924	Willem Einthoven, M.D.	Leyden (Holland).
April 21, 1925	A. N. Richards, A.M., Ph.D.	Philadelphia.
Feb. 2, 1927	Eugene L. Opie, M.D.	Philadelphia.
Nov. 2, 1927	George R. Minot	Boston.
Mar. 22, 1928	Sir Humphry Rolleston, Bart., M.D.	Cambridge (Eng.).
Nov. 7, 1928	Ralph Pemberton, M.D.	Philadelphia.
Oct. 2, 1929	Joseph Barcroft, C.B.E., F.R.S.	Cambridge, (Eng.)

MÜTTER LECTURES

1865	J. H. Packard, M.D.	Philadelphia.
1866	J. H. Packard, M.D.	Philadelphia.
1867	J. H. Packard, M.D.	Philadelphia.
1868	Harrison Allen, M.D.	Philadelphia.
1869	J. H. Brinton, M.D.	Philadelphia.
1872	J. da S. Solis Cohen, M.D.	Philadelphia.
1879	S. W. Gross, M.D.	Philadelphia.
1882	E. O. Shakespeare, M.D.	Philadelphia.
1885	H. F. Formad, M.D.	Philadelphia.
1888	O. H. Allis, M.D.	Philadelphia.
1890–1891	Roswell Park, M.D.	Buffalo.
1893–1894	De Forest Willard, M.D., and Guy Hinsdale, M.D.	Philadelphia.
1896	O. H. Allis, M.D.	Philadelphia.
1899–1900	J. B. Roberts, M.D.	Philadelphia.
1901	H. W. Cushing, M.D.	Boston.
1902	L. A. La Garde, M.D.	Washington.

1903	C. N. B. Camac, M.D.	New York.
1904	G. H. Monks, M.D.	Boston.
1905	A. O. J. Kelly, M.D.	Philadelphia.
1906	W. J. Mayo, M.D.	Rochester, Minn.
1907	J. Rogers, M.D., and S. P. Beebe, M.D.	New York.
1908	G. W. Crile, M.D.	Cleveland.
1909	H. D. Fry, M.D.	Washington.
1910	T. W. Hastings, M.D.	New York.
1911	C. F. Nassau, M.D.	Philadelphia.
1912	J. C. Bloodgood, M.D.	Baltimore.
1913	R. C. Coffey, M.D.	Portland, Ore.
1914	F. H. Albee, M.D.	New York.
1915–1916	Rudolph Matas, M.D.	New Orleans, La.
1916	Nelson M. Percy, M.D.	Chicago, Ill.
1917	Chevalier Jackson, M.D.	Philadelphia.
1919	Alexis V. Moschcowitz, M.D.	New York.
1920	J. Chalmers Da Costa, M.D.	Philadelphia.
1921	Prof. H. C. Jacobaeus	Stockholm (Swed.).
1922	James Ewing, M.D.	New York.
1923	J. Edwin Sweet, M.D.	Philadelphia.
1924	Evarts Graham, M.D.	St. Louis.
1925	Edward Archibald, M.D.	Montreal, Can.
1926	Walton Martin, M.D.	Ithaca, N. Y.
1927	E. Starr Judd, M.D.	Rochester, Minn.
1928	Herbert W. Carson, M.D.	London (Eng.).
1929	Robert B. Greenough, M.D.	Boston.

WEIR MITCHELL ORATION

1919	Charles W. Burr, M.D.	Philadelphia.
1922	Charles Loomis Dana, M.D.	New York.
1925	Simon Flexner, M.D.	New York.
1928	Frederick Tilney, M.D.	New York.

MORRIS J. LEWIS, M.D.

MEMOIR OF MORRIS J. LEWIS, M.D.*

By CHARLES W. BURR, M.D.

Morris J. Lewis, born in Philadelphia on March 25, 1852, was the son of Saunders Lewis and his wife, Phoebe Morris James, and the grandson of Dr. Thomas C. James. In 1860 he entered Dr. Faries' Classical Institute, a school famous in its day and having at its head a great schoolmaster, who did not agree with the present-day popular idea that school should be made one long sweet holiday and believed that he who spares the rod spoils the child. He continued there until his graduation, seven years later, and then, when sixteen years of age, entered the College of the University of Pennsylvania, receiving his bachelor's degree in 1871. He passed into the medical school of Pennsylvania and, though the regular course occupied two years, deliberately chose a three-years' course. He was graduated M.D. in 1874 and at the same time received a master's degree and a Ph.D. He then became resident physician at the Pennsylvania Hospital, and years later, in 1890, was elected visiting physician, holding the position twenty-seven years. On the completion of his internship he began general practice. His brother, Mr. Saunders Lewis, tells me that he wanted to be a surgeon, but that when he showed Dr. D. Hayes Agnew an irritable scar on his right index finger, the result of an injury in boyhood, Dr. Agnew told him it would never do for him to be a surgeon because, since the scar frequently cracked and oozed blood, the risk of infecting himself was too great. He, therefore, became an internist and, through his association with Weir Mitchell, became especially interested in neurology. He married Maria H. Drayton, the daughter of William Heyward and Harriet Coleman Drayton. They had no children.

He had long years of hospital experience; was visiting physician at the Episcopal Hospital for nine years, and for several years at the Children's Hospital. But I think his favorite was the Orthopædic Hospital and Infirmary for Nervous Diseases. He was, first, assistant, and later chief, succeeding William Osler. His colleagues on the staff were Weir Mitchell, Wharton Sinkler and W. W. Keen. They were all outstanding men in the development of neurology.

* Read May 6, 1929.

He was elected a fellow of this College in 1877 and was active as Fellow, Councillor and committee man for almost half a century, until age made him inactive.

He was a strong believer in organized medicine and was a member of the national, state and county societies, as well as the Association of American Physicians, the American Neurological and the local Pathological, Neurological and Pediatric Societies.

He was an active and useful trustee of the University of Pennsylvania for twenty-six years, from 1896 until 1922. He was a manager of The Wistar Institute of Anatomy and Biology from 1898 until his death.

Most of his contributions to medical science (and though they were not numerous, they were thoughtful, careful and showed accuracy in observation and conservatism in generalizing) had their origin in his work in The Infirmary. He discovered the chin jerk. He was associated with Weir Mitchell in much of his later work on nerve-muscle physiology. He wrote several papers on the seasonal relations of chorea and was the author of the paper on "The Neural Disorders of Writers and Artisans" in *Pepper's System.* Dr. de Schweinitz lists twenty-five papers in his memoir written for the Wistar Institute.

He died on April 16, 1928, from chronic cardiorenal-vascular disease, after an illness of about eighteen months.

So much for the externals of his life. Now a word as to the man himself. What manner of man was he? First, as to his pleasures and hobbies, for these things, though commonly thought to be unimportant, really throw much light on character. As a boy, and, his brother tells me, even while he was an intern at the Pennsylvania Hospital, he had a hobby that no one would ever guess. He was very fond of making fireworks and was greatly skilled therein. All through life he was fond of mechanical things, fixing clocks, making electric fixtures and the like. He also was interested in photography. He studied botany from youth up, but only in a classificatory way. Though he lived through the long period in which the great fight for and against Darwin lasted, he had no intellectual interest in the evidence botany offered in proof of evolution. He merely accepted it. His favorite sport was hunting, and he shot many a fine specimen of moose, caribou and mountain sheep. He loved the outdoors, Nature uncivilized and free from the smell of gasoline, the noise made by man herded together in great cities, night skies not hidden by electric light signs. His tastes were simple.

On the more serious side, the most striking thing about him was integrity. I do not believe he ever did an evil thing in his life. He sometimes did the wrong thing, or took the wrong side, but it was never because it was to his advantage to do so, never through selfishness, but always because he misinterpreted the facts. He was a shy man, not the shyness of fear, but of self-containment. He was largely sufficient to himself. He was intellectually modest and fact-minded and cared nothing for the generalizations of science. They were outside his mental world. He never read a book save to get facts. Medical books and journals he read largely, and kept well informed on scientific and therapeutic matters, but literature he cared nothing for. He was both broad and narrow—an apparent, not a real contradiction. His intellectual world was narrow (internal medicine), but within that sphere he was liberal-minded, accepted new ideas readily, even though they were opposed to his old opinions.

He was a kind man and the doctors' doctor. He had a large clientéle among doctors (many of them years younger than himself) and no man was ever more attentive to them and to their families when ill. He was as attentive to poor patients as to rich. I know of many poor families whom he treated, with care and skill, over two generations, and when he had gained reputation charged them no more than when he was an unknown young physician. He was one of the clumsiest men in the sick-room I have ever known. If there was anything to knock down, down it went; if anything to stumble over, it was stumbled over. He had a curious way of talking by gesture, with his elbows and shoulders, and as these gestures were idiosyncratic, and were interjected suddenly, in the course of ordinary speech, the listener was sometimes greatly perplexed.

He was altogether fact-minded. Beyond facts his curiosity did not go. But as to facts he was inquisitive, accurate, observant, and had excellent eyes and ears. Theories made no appeal to him. Hypotheses were abhorent. He totally lacked a sense of humor, and cared for and appreciated only the mildest sort of fun. But he was by nature quietly happy.

He was clear-thinking and clean-souled. He attained medical wisdom and all his reflexes were wholesome. His power of inhibition was excellent. Altogether he was a type of man the world, especially our American world, much needs today. He did his work in life honestly, faithfully and well, and endured to the end.

JOSEPH SAILER M D

MEMOIR OF JOSEPH SAILER, M.D.*

October 1, 1867 December 31, 1928

By TRUMAN G. SCHNABEL, M.D.

One night after dinner, forty-two years ago, Joseph Sailer announced to his father that he was finished with his brief banking experience of eight months as clerk in the Independence National Bank and that he had decided to study medicine. He was then nineteen years of age; had been educated in a small private school and later in the public schools of Philadelphia; had entered the University of Pennsylvania at fourteen and had graduated at eighteen from its Biological Department with the degree of Bachelor of Philosophy. His ancestry was English. His paternal grandfather had been for years financial editor of the *Public Ledger*, while his father, John Sailer, was a successful and highly esteemed banker in his native Philadelphia. His mother was Emily Woodward. Small wonder, then, that his father was greatly disappointed in his son's decision. It seemed that with every advantage afforded by birth and opportunity, "Joe Sailer," as he was always affectionately known, was turning aside an almost assured future for one with much uncertainty in its pathway. But this embryo doctor had always been studious, quietly determined, modest and, above all, possessed of a precociously mature philosophy, factors which were of tremendous importance in coloring his medical career and attributes which his father probably did not appreciate at the time. During the first slowly-shaping years of the son's medical life the elder Sailer still doubted the wisdom of that earlier decision; but as he saw success coming to that son from all sides, he was silently pleased, and it is regrettable that he did not live for sixteen more years to see the final position in medicine to which Joseph Sailer had achieved when he was called by the Great Physician on December 31, 1928.

After what seemed rebellion to the father, young Sailer went to Darmstadt and studied the German language. On his return, he entered the medical school at the University and graduated with the class of 1891. For his thesis he undertook and completed a very

* Read May 6, 1929.

excellent piece of investigation on "The Physiological Action of Ouabain." The essay, detailing his experiments and observations, won for him the *Medical News* prize of that year. It was published in the *Therapeutic Gazette* in the fall of 1891, and was the first of more than one hundred and twenty-five of his contributions to medical literature. Its lines were prophetic of a subsequent life filled with sustained enthusiasm, painstaking work, keen observation, careful analysis and logical deduction.

After graduation he interned at both the Presbyterian and Philadelphia hospitals. Then came an eighteen months' period of study in European laboratories under such masters as Von Monakow, Charcot, Dejerine, Neisser and others. He returned in September, 1895, and began to work as his classmates had predicted, largely in the laboratory and in the autopsy room. Much of his time during his early years was spent in the Pepper Clinical Laboratory, in the Department of Pathology, as demonstrator under Dr. Simon Flexner, and in pathological positions at different institutions, including the Pennsylvania Training School for Feeble-minded Children, the St. Joseph's, the Maternity, the Presbyterian and the Philadelphia hospitals. At the same time he had associated himself as assistant to the elder Musser and was keeping an eye on clinical work in the University and Philadelphia General Hospitals. In these first years after Europe he was prolific. In them he reported studies touching on immunity, numerous pathological observations and wrote some noteworthy clinico-pathological papers. During these years, with the inspiration of his European studies back of him, he was primarily interested in diseases of the nervous system, chiefly as a neuropathologist, but also as a clinician. He was always busily engaged in correlating his bedside medicine with the post-mortem-table findings, and, as many others have done, gradually shifted into clinical practice, much to the surprise of his former friends.

The position of professor of diseases of the stomach and intestines at the Philadelphia Polyclinic came to him in 1902 and apparently changed his major interests to gastroenterology, and this is the second period, which stands out very clearly in his medical life. In these years he made some original studies in gastric secretion, and became especially interested in Glénard's disease, gastric ulcer, gastric carcinoma and the possibilities of the *x*-ray method in the diagnosis of diseases of the alimentary tract.

In the Spanish-American War he was an assistant surgeon in the Naval Reserve battalion. In the World War he served with distinction in the Army Medical Corps both at home and abroad. It was said of him in his military service that "Wherever he went he immediately created an atmosphere of confidence and his own conscientious devotion to duty inspired his fellow-officers and won for him the love of every suffering doughboy."

After the war, with the electrocardiograph made easily available for clinical work, he renewed, it seemed, his old and always live interest in cardiology. This third period, too, stands out clearly in his writings with many valuable and original contributions. But it is in a larger way that this part of his life is to be remembered, because he organized the Philadelphia Association for the Prevention and Treatment of Heart Disease, a part of the larger national body having the same objective. He served as president of both the parent and offspring organizations. It was due to his efforts and interest that a new Children's Heart Hospital was built on Falls Road and this new institution opened its doors during the last days of his life. It serves as a silent memorial to his interest in cardiac disease and more especially those in the community afflicted with diseases of the heart.

Not a small portion of his days was given to undergraduate and graduate teaching of medicine. For the last fifteen years of his life he held the chair of clinical professor of medicine in his Alma Mater. As a teacher he was quietly forceful in presentation. He always showed a thorough mastery of his subject. "His clear and incisive mind enabled him to make easily comprehensible and even vivid to his students the conceptions which he had formed." He always showed very clearly his deep-rooted interest in the history, the development and philosophy of medicine. A host of students throughout the country owe him a lasting debt of gratitude for having guided them aright in the best traditions of Philadelphia medicine. He was at one time or another physician to the Charity, Howard, Philadelphia, Polyclinic, University and Presbyterian Hospitals.

He was elected to fellowship in this College of Physicians, February 3, 1897. He served on the Alvarenga Prize Committee for 1902 and 1912. He was elected chairman of the Section on General Medicine in 1909. He served on the Finance Committee for five years and was chairman of the committee on the Weir Mitchell

Oration. He made at least nine scientific presentations to the college, including some interesting studies on aortic regurgitation, the relationship of tuberculosis to pseudoleukemia, exophthalmic goiter, chronic pancreatitis, cecum mobile and congenital high scapula (Sprengel's disease). Before the Section of Medicine, he made at least thirty presentations and throughout the proceedings of the larger body and its sections appear innumerable reports of discussions by the subject of this memoir. Thus he played an important part in the life of our college.

He belonged to the leading medical organizations of this city and the nation, in many of which he held at one time or another executive and administrative positions. He frequently appeared on their stated scientific programs and entered freely and very cleverly into discussion of papers.

Joseph Sailer had carefully trained himself by study and travel. As a young man he was always apparently more mature and more philosophical than his friends of the same age. His interests took him far beyond the confines of medicine into cultural and artistic fields. On occasions he astounded one with his breadth of accurate information. He had an interesting and sizable library, which reflected its owner's wide and unusual interests in life. He had collected a splendid lot of engravings and etchings, chiefly of the line variety. Of the latter he had good examples of the best-known masters of this art, including thirty-five fine subjects from the burin of Robert Nanteuill, the greatest painter-engraver of the seventeenth century. He loved the beautiful in art. He collected semiprecious stones. He played a good game of chess. His best athletic adventure was fencing, although he swam, played tennis, rode horseback and, in the days of the bicycle, enjoyed "wheeling" it through the country. He took numerous walking trips in Europe. He was especially interested in the history of the Monguls and was a close student of Genghis Khan.

In 1901 he married Mary Lowber Strawbridge. In spite of a tremendously full life, made especially so by an exacting and large private and consulting practice, he loved his home with its seven children and their mother. With them he always seemed as a child himself.

Frequent allusion has already been made to the manner of man we have lost. His patients probably knew him better than many others. They appreciated his painstaking studies, his advice as a

doctor and a friend. He seemed to understand their viewpoint in an uncanny sort of way. On one occasion a nurse complained to him that her patient was constantly demanding a harmless P.R.N. order. Looking at her for a moment, he replied, "Have you ever been sick yourself?" and then walked on without further comment. His patients came before every other interest. He fought for them. He frequently set a difficult task for the nurse, the resident, the laboratory man and the surgeon. Often the problem seemed unsolvable, but still he insisted. He had vision. Many things which Joseph Sailer predicted years ago have since been realized in the full. His bibliography reveals an unusual interest in the rarities of medicine and an almost supernatural skill in picking them out. His last published clinic concerned itself with a case of psittacosis. Many remember some seemingly wild diagnoses made and subsequently proved to be correct. This constituted his only tendency to sensationalism. In all other respects he was most unostentatious and modest. He was esthetic. He was a gentleman always; clean of speech and mind. Perhaps this is enough.

> Of the things we say or do or think, when alive,
> Oh, so few there are to survive!
> When we are dead,
> How few there are can be said!

For a year or two before his death Dr. Sailer found it increasingly difficult to carry on. He did so, however, with the spirit of a man who found life interesting and worthwhile. As was his habit in his earlier years, so in the last months, he never refused to see a patient or go in consultation even though he was weary and might have justly declined. When severely sick and very miserable, he was cheerful and hopeful. Always considerate of his nurses, his physicians and family.

His friends and patients gathered together in Old St. Peter's on the third day of this year. As we sat in that venerable house of God and thought of him to whom we were paying our last respect and honor, there occurred to me that beautiful memorial poem written a long time ago:

> "A late lark twitters from the quiet skies;
> And from the west,
> Where the sun, his day's work ended,
> Lingers as in content,
> There falls on the old, gray city
> An influence luminous and serene,
> A shining peace.

"The smoke ascends
In a rosy and golden haze. The spires
Shine, and are changed. In the valley
Shadows rise. The lark sings on. The sun,
Closing his benediction,
Sinks, and the darkening air
Thrills with a sense of the triumphing night—
Night, with her train of stars
And her great gift of sleep.

"So be my passing!
My task accomplished and the long day done,
My wages taken, and in my heart
Some late lark singing,
Let me be gathered to the quiet west,
The sundown splendid and serene,
Death."

MEMOIR OF ROBERT ABBE, M.D.*

By WILLIAM J. TAYLOR, M.D.

Dr. Robert Abbe was born in New York City on April 13, 1851, the son of George Waldo and Charlotte Colgate Abbe, and died in New York City, March 7, 1928, in the seventy-seventh year of his age.

He was educated in the public schools and the College of the City of New York, from which he was graduated in 1870, and for two years thereafter he taught drawing, geometry and English in that College.

He graduated in medicine, in 1874, from the College of Physicians and Surgeons, and served an internship at St. Luke's Hospital. He was then invited by Dr. Robert F. Weir to become his assistant in his private practice.

He was soon recognized as a leader in surgery, with an irreproachable technic, and did much pioneer work in surgery of the gastro-intestinal tract, in cerebral, spinal and plastic surgery. He devised the earliest and, as Dr. Gibson aptly states, possibly the best method of treating impassable strictures of the esophagus. When his attention was called to the remarkable work of the Curies, he at once saw the great possibilities of the use of radium in the treatment of cancer, and was one of the first, if not the first, to obtain a considerable quantity of it, and in its surgical use was a pioneer.

He did important research work on the action of x-rays in the Babies' and Roosevelt hospitals, served for a time as professor of surgery in the Woman's Medical College, and as professor of surgery in the Post-graduate Medical School and the College of Physicians and Surgeons. Elected to St. Luke's Hospital in 1884, as attending surgeon, he retained his connection on the active staff for years and was associated as consulting surgeon with it and several other large hospitals.

He was a member and fellow of many societies: The American Surgical Association, the International Surgical Society, the New York Surgical Society, the American Medical Association and other medical societies, and was an associate Fellow of this College. He was especially interested in the work of the Practitioners' Society of New York and made many contributions of papers, of case histories

* Read May 6, 1929.

and of models, made and colored by himself, of the results of radium in malignant diseases, and contributed much to surgical literature on many subjects. He had a very charming personality and great enthusiasm. At the age of seventy he flew from London to Paris. He had almost no enemies and a great host of friends. His early studies in drawing and his knowledge of geometry helped him to make a fine relief map of Mt. Desert Island, and also, by many soundings, a similar map of the bottom of the bay in Salisbury Cove, at the Weir Mitchell Station of the Mt. Desert Island Biological Laboratory. "Brook End," his summer home at Bar Harbor, was his great delight, and for several years before his death he went from New York to it by airplane as by far the least fatiguing mode of travel. The finding of some prehistoric relics of the unknown people who inhabited Mt. Desert Island led Dr. Abbe to collect these evidences of the earliest civilization on the island, and, with the help of friends, his collection finally became an endowed museum of prehistoric man on Mt. Desert Island.

On August 14, 1928, four months after Dr. Abbe's death, a beautiful small building with a suitable endowment was publicly dedicated, at which many speeches were made which showed the warm, affectionate regard in which he was held by all the people of Bar Harbor.

Dr. Abbe, as you all well know, was a most loyal Fellow of this College and a great benefactor, taking the greatest interest in it and giving most generously to it of his time and money. He established the Rush Custodianship, having made the cabinet in which to hold our precious relics and endowed it most generously. It was due entirely to his efforts that we possess the instrument fashioned by Prof. Pierre Curie at the Sorbonne, and employed by him and Mme. Curie to determine the strength of electron discharge from radium. This was personally presented by Mme. Curie on May 23, 1921, at a special meeting of the College.

Four years before Dr. Abbe's death, anemia developed, which resisted all efforts at cure, and it was suggested that this was possibly induced by the long-continued handling of radium. For this anemia he was transfused every three weeks, which produced only temporary benefit. In spite of this he retained his cheerfulness and interest in life to a remarkable degree.

In 1891 he married Mrs. Charlotte A. B. Palmer, who died many years ago. They had no children.

THE ANNUAL ADDRESS OF THE PRESIDENT*

By JOHN H. GIBBON, M.D.

It is nearly as difficult to write as to listen to a presidential address.

Owing to the recent changes in our by-laws, which eliminate the reading of the reports of certain officers and committees, the address of the President becomes of necessity rather an epitome of the various activities of the College during the previous twelve months.

Finances. The College of Physicians today faces a serious financial situation, and I shall again earnestly invite the attention of the Fellows to certain facts relative to our finances which demand careful consideration on the part of all those who have the welfare of the institution at heart. I am told constantly that many Fellows have no idea at all of the financial condition of the College and even some think that we have all the funds necessary to carry out our work. There is no excuse for such ignorance, unless it be that the previous addresses of your presiding officers have not been read. A very full report of our financial status was given in the last address, but this received the usual interment in our *Transactions*, and we now have, I suppose, few "resurrectionists" in our Fellowship. The Council, however, has decided that the present report be printed and sent to every Fellow, and it is hoped that some at least will be good enough to read it and inform themselves of the situation in which the College stands today.

The condition can be described in a few words. We are now, and have been for several years, spending about $20,000 a year beyond our income, and this deficit has been made up from a small permanent fund which has now been decreased by some $50,000. This, briefly, is our condition and it must be met. Shall we go on spending our small principal, hoping, Micawber-like, for something to turn up; or shall we, by increasing the dues or by making an assessment on the Fellows, endeavor to make up our deficiency?

* Read January 6, 1930.

Some will ask how the College arrived at such a point, and the answer is very simple. Up until a few years ago we received a rental of $10,000 a year from our Locust Street property and paid no tax. With the removal of the Free Library we lost the $10,000 rental and had to pay the taxes, which amounted to practically $10,000 a year; here, then, lies the simple explanation of our shortage. As simple would appear the answer—sell the property. This has been our endeavor for several years, and we thought at one time that we had sold it, but the purchaser was unable to raise the funds necessary to make the first payment, although the College profited to the extent of $7500, which was paid as an option. Since this affair there has been no offer for the property. During the past twelve months the old College building has been demolished and we are now receiving a rental of about $4000 from a tenant who is using the ground as a parking space. This sum, however, amounts to less than one-half our taxes.

I think that our difficulties might be considered under three heads: First, our annual shortage; second, the serious reduction of our permanent fund; and third, the certainty of increasing expenses in the future conduct of the College. These matters have received, and are still receiving, the anxious consideration of the Council and the Finance Committee.

At a recent meeting of the Council it was determined to solicit contributions which will go into a special fund, the income of which may be used for defraying the regular expenses of the College. Although the details as to how this solicitation shall be made have not yet been decided, I hope that each Fellow of the College will give the matter some serious consideration and that this may result in individual gifts or bequests to this particular fund. Already several Fellows of the College have made bequests in their wills, and I think it is one way in which the College can help itself. Of course, few Fellows are able to make large contributions, but many, I am sure, could leave the College at their death sums which would materially aid the institution in the future.

Some of you probably have in mind previous gifts and bequests, but I would call your attention to the fact that these have been made for specific purposes and the income cannot be used for the general expenses of the College.

The income of the College available for current expenses, aside from the annual contributions which amount to $12,500, is less

than $6000; to this, of course, should be added the $4500 rent from the Locust Street property, making the total for general expenses a little over $22,000 Against this we have a budget for the present year of about $44,000.

Even with the sale of the Locust Street property our financial situation will not be satisfactory. If this institution is to function as it has done for nearly one hundred and fifty years, it must have money and the Fellows must either give it or get it.

Meetings. Owing to the activity of the Committee on Scientific Business there were eighteen valuable papers read at nine meetings.

The ninth Nathan Lewis Hatfield Lecture was delivered, on February 6, by Dr. Simon Flexner, of New York, his subject being "Epidemic and Postvaccinal Forms of Encephalitis."

On October 2 the twenty-first Mary Scott Newbold Lecture was delivered by Prof. Joseph Barcroft, of Cambridge University, his subject being "Alterations in the Volume of the Normal Spleen and Their Physiological Significance."

On November 6 the College celebrated the one hundredth anniversary of the birth of Dr. S. Weir Mitchell, at which the fourth Mitchell oration was delivered by Dr. Frederick Tilney, of New York, his subject being "The Structural Basis of Behaviorism."

On December 4 the Mütter Lecture was delivered by Dr. Robert B. Greenough, of Boston, his subject being "The Surgeon and Cancer."

The Alvarenga Prize for 1929 was awarded to Dr. George M. Dorrance for his essay entitled "The Congenital Insufficiency of the Palate."

Two Business Meetings were held during the year, at the second of which memoirs of the following Fellows were read: Dr. Robert Abbe, by Dr. William J. Taylor; Dr. Morris T. Lewis, by Dr. Charles W. Burr; Dr. Joseph Sailer, by Dr. Truman G. Schnabel.

Membership. On December 1 our Fellowship numbered 540, of which 522 were active Fellows, 10 were American Associate Fellows and 8 were Foreign Associate Fellows.

Deaths. Ten active Fellows and one Associate Fellow died during the past year. You have heard memoirs read of four of these Fellows, Drs. Sailer, Morris, Fenton and Sajous.

Dr. Harry Toulmin, elected a Fellow in 1896, died on February 8, 1929. The greater part of Dr. Toulmin's life was devoted to insurance, and for many years he occupied the position of medical

director of the Penn Mutual Life Insurance Company. Aside from his professional activity, Dr. Toulmin was conspicuous for a lovable character.

Dr. Lewis Brinton died on March 13, 1929. He was elected a Fellow in 1891. Dr. Brinton devoted himself assiduously during his professional life to the study and treatment of gastrointestinal diseases.

Dr. George Fales Baker was elected a Fellow in 1892 and died on June 3, 1929. Although never engaged in the active practice of medicine, Dr. Baker was deeply interested in the welfare of the College, and was, for a long span of years, chairman of the Committee on Finance, where his judgment and counsel were of great value.

Dr. Paul A. Lewis was elected a Fellow in 1911 and died on June 30, 1929. Dr. Lewis, although at the time of his death a resident of Princeton, N. J., will be remembered for his accomplishments in the field of pathology in Philadelphia, where for a number of years he was associated with the University of Pennsylvania, the Phipps Institute and the Pennsylvania Hospital.

Dr. S. MacCuen Smith was elected a Fellow in 1905 and died on September 14, 1929. For many years he was professor of otology at the Jefferson Medical College and occupied a very conspicuous position in the field of otology. He was an excellent teacher and a skilful operator.

Dr. Samuel S. Stryker died on October 25, 1929. Dr. Stryker was one of the oldest Fellows of the College, having been elected in 1884. At the time of his death he was consulting physician to the Presbyterian Hospital. Probably no one in our Fellowship was more respected and loved than Dr. Stryker.

Dr. Samuel S. Keass died on December 7, 1928. Dr. Keass was elected a Fellow in 1895. In the early part of his professional life he was actively engaged in pathological work and all his life took a deep interest in the welfare of this College.

There have been three unrecorded deaths in the Associate Fellowship. No mention has been previously made of the distinguished Thomas Addis Emmet, of New York, elected in 1892, and who died on March 11, 1919.

One of our oldest Associate Fellows, Dr. Fleming Carrow, of Detroit, died on June 23, 1928. He was elected in 1880.

Dr. Frederick C. Shattuck, of Boston, died in his eighty-second

year on January 11, 1929. He was elected in 1906. Dr. Shattuck's life was an exemplary one in a city noted for the high type of her medical men.

The chair would also like, in this connection, to say a word in appreciation of one who in his legal capacity served this institution well for many years and was always ready and anxious to give it the benefit of his wise counsel, the Honorable Hampton L. Carson, who died, July 18, 1929.

The Library. Our greatest asset is the Library and its function is the most important one of the College. The Library has suffered because of the necessary curtailment of our expenditures during the past few years. Nearly all the funds given to the College have been for the Library, but the income from these has not been sufficient to keep it up to date. It is true that our present need is an endowment for the general upkeep of the College, but any part of the income of such a fund can always be assigned for Library expenses. During the past year there have been added to our shelves 5007 volumes, 15,506 pamphlets and 11,891 numbers of various periodicals. By gift and purchase, 5 Incunabula have been acquired, bringing the total to 387, and in addition some 30 rare volumes have been added to our list.

The Library funds have been increased by a bequest of $2910 to the Samuel D. Gross library from Lady Osler.

The Nurses' Directory has continued efficiently its important function, to the benefit of the sick, the physician and the College.

The Sections. All the sections of the College have been most active during the past year, with manifestly greater interest and larger attendance.

In concluding my second year as your presiding officer, I want to thank my fellow officers, the members of the Council and of the various committees for their kind consideration and coöperation, and, in behalf of us all, I would express our appreciation of the conscientious and faithful services of all the employees of the College.

MYCOTIC ANEURYSMS*

By W. G. MacCALLUM, M.D. (By Invitation)
BALTIMORE, MD.

The literature contains many descriptions of aneurysmal sac formation in various positions due to the destructive activity of bacteria. All writers agree as to the influence of the pressure of the blood in causing the distention of such weakened places, but there is less unanimity of opinion concerning the way in which the bacteria reach the part of the vascular system which becomes weakened. Except for this the matter is not very complicated, and the early papers of Eppinger and Ribbert, followed by many others which contain descriptions of cases, present the whole matter fairly well. The following is intended mainly to record a number of cases, partly by photographs, and to give some idea of the relative frequency of this affection in various situations.

The idea of Ponfick that cuts or tears in the walls of bloodvessels are produced by sharp, angular emboli broken from calcified heart valves, has been generally abandoned. The theory that bacteria in infected emboli or from the bloodstream are carried into the vasa vasorum of the vessels in which mycotic aneurysms occur, producing an infection primarily of the external coats, has been upheld by some to explain the aneurysms of the aorta; but there is little direct evidence for this, and Grant points out the fact that if this were the explanation, it would be surprising that, while such aneurysms occur in the aorta near its origin, they are rarely found in the pulmonary artery, although branches of the coronary arteries are sent to both as vasa vasorum.

On the other hand, it is perfectly clear that many of such aneurysms are due to the extension of infection from a bacteria-laden embolus, through the intima and into the media of the artery. In other cases it is quite as clear that in acute endocarditis the tearing of a heart valve upon which there is an infected thrombus mass often allows that part of the valve to flap loosely back and forth, and thus

* Read January 7, 1929.

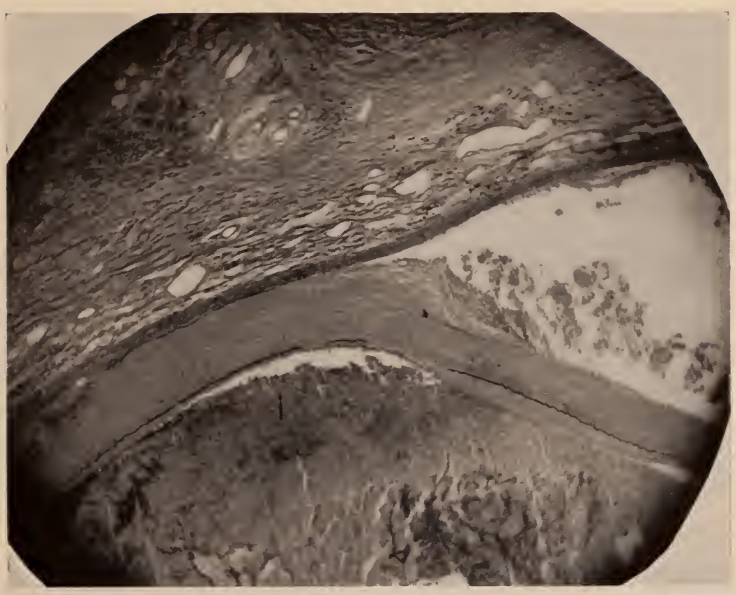

FIG. 1, 10338.—Embolus in gonococcal endocarditis, showing destruction of the wall of the femoral artery from within.

FIG. 2, 10619.—Embolic mycotic aneurysm of the superior mesenteric artery in gonococcal endocarditis.

Fig. 3, 10916.—Mycotic aneurysm of the hepatic artery in a child

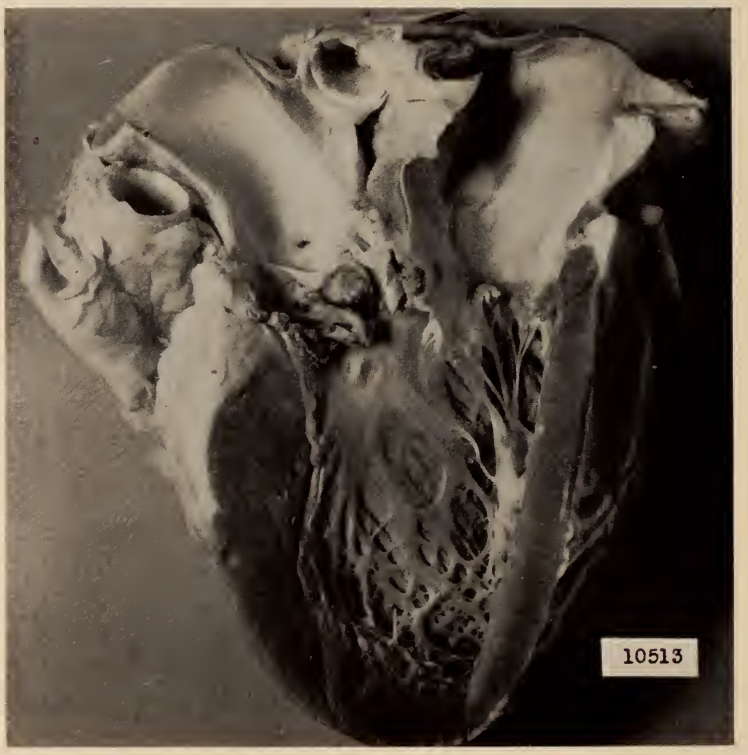

Fig. 4, 10513.—Aortic endocarditis due to Streptococcus viridans, with implantation aneurysm of mitral valve, shown in section.

to implant bacteria upon whatever it touches. Most commonly a loose, flapping portion of an aortic valve sows bacteria on the adjacent wall of the aorta and on the ventricular surface of the mitral valve. Finally, in rather rare cases, an abscess or other area of intense infection impinging upon the outside of the aorta or other large artery, may erode the wall and produce either a saccular dilata-

Fig. 5, 10088.—Aortic endocarditis due to the Streptococcus viridans, with implantation aneurysms of the mitral valve, shown in section.

tion or a hemorrhage into the cavity already existing outside. Possibly we should include here the aneurysmal dilatation of small arteries in the wall of a tuberculous cavity, or even, although they are not plainly due to bacterial action, those in the base of a gastric ulcer.

There remains a difficulty in explaining the mode of access of the

bacteria in those cases in which a sac arises from a point in the smooth wall of the aorta, too far away from the valves to have been due to direct implantation. It is almost equally difficult to believe that bacteria have merely lodged on the intimal lining at that point, or that they have passed into the vasa vasorum and grown to great numbers at that point alone.

Fig. 6, 2188 B.V.—Aneurysmal sac projecting into the auricle from the surface of the mitral valve.

The following cases illustrate these different groups:

I. Mycotic aneurysms in arteries, plainly due to extension of infection from an embolus lodged in the arterial lumen.

Of these, ten have occurred within the past ten years, and perhaps the most interesting is 10338, since it shows plainly the mode of formation of such aneurysms. It was a case of subacute gonococcal mitral endocarditis, with emboli in the left common iliac and femoral

arteries, also in the right iliac, femoral and popliteal arteries, and thrombosis of the femoral and right popliteal veins. There were no actual aneurysms, but the section shows the mode of injury and weakening of the artery wall. The elastic lamina is seen to be interrupted, and the intima and media deeply eroded, with a splitting of the media. In 10619, also a case of ulcerative gonococcal endo-

Fig. 7, 2188 B.V.—The heart shown in Fig. 6 from the ventricular side, showing the orifice of the sac and the aortic vegetations from which the implantation occurred.

carditis, there was an aneurysmal dilatation of the superior mesenteric artery, forming a sac filled now with a relatively fresh thrombus, and giving off in continuity the distal branches of the artery. In 8293, a case of endocarditis due to the Streptococcus viridans, there had been many successive occlusions of bloodvessels by emboli. The left radial artery was obliterated; there had been obstruction of the left femoral artery with the formation of an aneurysmal sac

which was exposed by the surgeon who ligated the left external iliac. Some time after that another mycotic aneurysm appeared in the right common iliac. Similar was case 8027, also ulcerative endocarditis, caused by the Streptococcus viridans with various embolic lesions and a mycotic aneurysm of the superior mesenteric artery with rupture and hemorrhage. In another case of the same kind, 10124, there was a mycotic aneurysm of the basilar artery.

Fig. 8, 2188 B.V.—The heart shown in Figs. 6 and 7 in vertical section.

The Streptococcus viridans was, in our experience, the organism most often concerned in the production of such embolic aneurysms, and it was found under quite similar circumstances in 9008 where the aneurysm was in the popliteal artery, and in 9842, a girl, aged thirteen years, in whom the tricuspid valve was especially affected. Here there was a great thrombus mass in the left pulmonary artery and a mycotic aneurysm of the ductus arteriosus. In 10916, a child aged fifteen, the mycotic aneurysm was in the hepatic artery, at

its entrance into the liver. In 10943, also a streptococcal endocarditis but affecting the pulmonary valves, there was a mycotic aneurysm of a branch of the pulmonary artery deep in the lung. Thus of 10 cases of this type, 7 were due to the Streptococcus viridans, 2 to the gonococcus. Photographs of only 3 of these are given, although all are available in the records.

Fig. 9, 11047.—Aortic endocarditis with implantation on the back of the mitral valve.

II. Implantation aneurysms.

The aneurysms which are found in the mitral valve or in the proximal part of the aorta, when bacteria can be implanted there from flapping fragments of the infected aortic valve, are very characteristic, and in our experience common, although they are seldom mentioned. Seven cases occurred in this series, of which 6 are due to the Streptococcus viridans, 1 to the gonococcus.

The mechanism of the production of these lesions is clearly indicated by their position, which is exactly the point that could be

reached by the end of the loose, infected flap of the aortic valve, such as is commonly formed when a leaflet of the valve is eaten through at one side but remains attached by a stalk. In the mitral valve the aneurysms occur only on the aortic segment, and on its auricular surface present themselves as smooth, rounded sacs, while the orifice of the sac, roughened by thrombus material which may

Fig. 10, 11047.—Heart shown in Fig. 9; from the auricular surface of the mitral valve there projects a smooth sac.

almost fill it, is, of course, on the ventricular surface. This is well shown when the heart is cut through so as to bisect one of these sacculations (10513, 10088, 2188 B.V., 8346, 9008, 11047). The sacculation in the wall of the aorta near its origin is similar, but it burrows only into the tissue outside the aorta and there is no opportunity to present as a smooth walled sac.

When, as in 2492 B.V., there are no vegetations on the aortic valves and, nevertheless, the auricular surface of the aortic leaflet of the mitral presents a roughened sac whose mouth is found on the ventricular surface, we must suppose that a vegetation formed first on the auricular surface, the bacteria eroding and weakening the tissue at that place so that the ventricular pressure distends it into a sac.

FIG. 11, 2492 B.V.—Large vegetation on the auricular surface of the mitral valve, forming a sac with rough exterior.

It seems unnecessary to add anything more except the illustrative figures, which are like those published some years ago by Grant.

In some cases, however, it seems hardly permissible to suggest the designation, mycotic aneurysm, when the infection, as in 6901, 1306, 10326 and 8101, burrows into the thick wall of the heart.

Fig. 12, 2492 B.V.—Heart shown in Fig. 11. The mitral valve viewed from the ventricular surface, showing the orifice of the sac which is forced out where the bacteria have weakened the tissue.

Fig. 13, 10984.—Mycotic aneurysm of the aorta caused by the Streptococcus viridans. The sac opens, as the vertical sections show, above the aortic valves, upon which there were no vegetations.

This is more like an abscess formation in continuity with the valvular vegetation. In the 4 cases of this kind which occurred in this series 2 were due to the gonococcus, 2 to the pneumococcus.

FIG. 14, 8756.—False aneurysm of mycotic origin, due to perforation of the wall of the aorta by an abscess.

III. Mycotic aneurysms of the aorta of obscure origin.

When there are no vegetations on the aortic valves, mycotic aneurysms in the wall of the aorta are difficult to explain. The two imaginable possibilities have been mentioned above, that they arise from accidental lodgment of bacteria on the intact intima or from embolism of the vasa vasorum at that spot. Two examples occurred one of which, 6545, caused by the gonococcus has been described in detail by Dr. Thayer; the other, in a child, 10984, caused by the

Streptococcus viridans, is quite similar in its structure to those resulting from implantation.

IV. Mycotic aneurysms from external erosion.

In contrast with all the cases already enumerated is the single case, 8756, in which a great abscess formed in the course of a Streptococcal septicemia following otitis media and sinus thrombosis, eroded the wall of the aorta, allowing blood to escape into the sac already formed. The process of erosion from outside is quite evident in the section through the orifice and in those through the wall of the aorta near the actual orifice. In principle, such an aneurysm resembles that recorded above, 2492 B.V., in which a sacculation of the mitral valve was caused by erosion of the auricular surface of the valve.

DISCUSSION

Dr. Alfred Stengel: There is not very much to say on the subject after what Dr. MacCallum has placed before us, so far as the pathological and etiological features of the matter are concerned, or the pathogenesis, which, I think, all of us are agreed with him, are pretty well established both by what he has shown us and by what has been observed by others along these same lines.

I have nothing particular to add to this except one or two observations of a clinical sort which, I think, I may be forgiven for introducing, though the subject has not been discussed from that angle. First of all, I want to reminisce, to say that my first acquaintance with this form of aneurysm was when I was a hospital intern and witnessed an autopsy at the Philadelphia Hospital performed by Dr. Osler, in which there were four aneurysms of the aorta from the descending arch down to the thoracic aorta, and which occasioned a comment of Dr. Osler regarding the occurrence of mycotic aneurysms. I am speaking so entirely from memory that, perhaps, I am not altogether accurate. I would suspect from what I know of these things that there was one pretty close to the heart, though my recollection is that they were all lower down, but these aneurysms, about the size of a medium-sized walnut, were all healed by the formation of dense laminated clots, such as have appeared in one or two of Dr. MacCallum's pictures here, so one might say that they were almost completely healed, and I remember so well, years ago as it was, hearing Osler say: "These are mycotic aneurysms." I do not care especially to use that word, but I suspect he did, at any rate he said these were infectious aneurysms such as occur in connection with infectious endocarditis. This was in 1890, but he referred to a case of his, of 1885, with healed aneurysm. I think the case he reported was in 1885. I do not think the second case, which I saw, was ever reported. The presentation made a tremendous impression on my

mind, and I felt for many years that I must, sooner or later, see one of these healed aneurysms in the making. I did not see any for some time, though with increasing pathological material I saw some suggestive cases, and, a few years ago, ran across several cases in quick succession that had certain interesting clinical features, too, so that Dr. Wolferth and I reported them in a paper that Dr. MacCallum referred to.

In regard to this matter of healing, I want to refer to a case reported by Dr. Wolferth and myself. A man, who had streptococcic endocarditis, developed in his femoral artery, in the position of the branching of the profunda, an increasing enlargement until it developed into the size of an aneurysm equalling a small lemon. It seemed to be increasing in size, and I was very much disturbed in mind what would become of it and asked Dr. Deaver to see it, and we gravely discussed putting on some of Halsted's clamps in case it increased in size. To my great amazement that aneurysm healed itself while the patient was under observation, and while his Streptococcus viridans infection continued, from which he eventually died. The aneurysm had healed, leaving a hard lump which was in process of contraction later on.

From the clinical standpoint, perhaps, what actuated Dr. Wolferth and myself particularly, was the possibility of recognizing these cases during life. The aneurysms I am speaking of now are those which are situated, as very many of them are, at or about the aortic valve and in connection with either the viridans or more acute forms of endocarditis. Now these aneurysms I am speaking of particularly—those which involve the root of the aorta itself, rather than the smaller ones, which involve the base of the mitral valve or aortic valve leaflets—produce a certain clinical picture which makes them recognizable, at least to a degree that one may make a pretty shrewd surmise that an aneurysm is present. If you will cast back your thoughts on cases of infectious endocarditis of acute malignant type or of the subacute viridans type, affecting the aortic valve, you will note this difference, that there is no marked dilatation of the arch, marked pulsation or excessively harsh murmur present in the ordinary case—three conditions which are notably present with these cases of infectious aortic-valve disease plus aneurysm.

This obliges me to go back a step to say, in regard to the root of the aorta in cases of aortic regurgitation or aortic valve disease, that the root of the aorta is most increased in size in cases of syphilitic aortitis, as shown by x-ray examination, and in cases of purely rheumatic valve disease. In neither of these cases is there the wild pulsation and marked palpability of thrill, the harshness, conspicuous character of the murmur, that you find when, in addition to infection, there is an aneurysmal involvement of the arch. Why this should be, one can only surmise, but the extent of infection there seems to make that distinction. Now it was upon this point in three of our cases—in one a surmise, and in the other two a certainty, as determined by autopsy—that an aneurysm was recognized.

I wish to refer for a moment to one other clinical case. I had hoped, indeed, that I might be able to show this patient here tonight, but we have been unable to get her to come. A young Italian girl in our service has

certain cardiac symptoms—palpitation of the heart, a clear rheumatic history dating back some years and, presumably, cardiac disease, developed at that time. She has the evidences of an aortic-valve lesion—she has an area of dullness on percussion which is very easy to mark out (none of us differ about it), extending well to the right, as if the aorta were very much enlarged. She is afebrile at the present time, having no evidence of infection. She is not syphilitic, both from serum tests and other investigation. She has this very marked condition, with murmur so loud that it is actually audible at a distance from the chest, and the thrill is so marked that one cannot put a hand upon the region without feeling that there is a marked pulsation. The *x*-ray examinations at first were rather unsatisfactory. On reëxamination subsequently very clear evidence, according to Dr. Pancoast and Dr. Pendergrass, was found of an aneurysm and dilatation of the aorta. I am speaking of this case at such length only to suggest that it may be an instance of rheumatic aneurysm. In the literature there are allusions to rheumatic disease of the heart with aneurysm formation. In such cases we think, if we may be pardoned for suspecting, there is an aneurysm. We believe it is an aneurysm. We do not believe it is a syphilitic aneurysm or a mycotic aneurysm, and regard it as an aneurysm associated with rheumatic heart disease. There are a number of such cases reported in French and German literature, some of which seem very doubtful and some suggestive. I am more tempted to speak of this subject because of newer ideas creeping into our literature in regard to the chronicity of rheumatism as an infection. Rheumatism, some of our friends are telling us now, is standing in a position equivalent to syphilis or tuberculosis, and is a very chronic infection which does not die out, but persists. If it is possible to produce such results as I am alluding to now, it is strange it has not been discovered before, common as it is. I could not resist the temptation of alluding to this case, unusual as it is, but nonsyphilitic, the etiology of it is entirely obscure, as we have been unable to find anything else.

Dr. MacCallum (closing): I feel just as Dr. Stengel says he does about the possibility of rheumatic aneurysm. I do not think that anything that has been reported has been at all convincing, but there seems no real reason why severe rheumatic infection should not weaken the aortic wall. I shall look forward with great interest to hearing the results of Dr. Stengel's case.

THE PROBLEM OF GASTRIC HYPERACIDITY*

By MARTIN E. REHFUSS, M.D.

Gastric hyperacidity has engaged the attention of medical men for many years; in fact, during the past decade it has been the practice of a not a few of the medical profession to diagnose hyperacidity as an entity rather than a symptom, and to regard it as a potential cause for many otherwise unexplained forms of indigestion. It was only when serious thought was given to this problem, and the experimental method was used to throw light on the subject, that serious doubts arose as to the importance as well as the significance of this symptom. Nothing has done more to throw light on this rather confusing subject than the physiologist on experimental animals and the clinical physiologist on normal, untraumatized individuals. It is difficult to understand the lack of serious study of the normal individual and the unqualified acceptance of the studies on the diseased patient, when the obvious thing would have been to study normal physiology as a basis for the interpretation of pathological responses.

I believe that it is universally recognized among physiologists that the acidity of the normal native gastric secretion when secreted above a minimum rate is somewhere between 0.4 and 0.5 per cent HCl. Many physiologists—notably Carlson, Umber, Hornborg, Seiler, Verhaegen, Sommerfeld and others—subscribe to this view. This figure, however, when translated into ordinary titration figures is that commonly accepted as clinical hyperacidity. We must begin, therefore, with the conception that the normal or native secretion is at or near this figure.

How, then, are we to explain the fact that such figures are not obtained with the ordinary Ewald test-meal, for instance? I believe that Hawk and myself have satisfactorily proven that in the normal subject bread and cereals (of which toast is an example) give the lowest acidities; on the other hand, in the same subjects,

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fish and meat give the highest acidities. Inasmuch as clinicians up until very recently have commonly tested the stomach with carbohydrate meals, it is apparent that the accepted normal figures would be relatively lower in range than those which are found with the normal pure secretion. It is interesting to note, for instance, that in 1000 studies on over 200 normal men, 7.3 per cent of the bread and cereal group; 39.3 per cent of the pies, cakes and cereal group; 91.5 per cent of the fish group; 76.8 per cent of the meat group; 20.8 per cent of the ice cream and beverage group; 22.1 per cent of the egg group; 36.1 per cent of the nuts and fruit groups; 44.6 per cent of the meal and gruel division, revealed at some point in their digestive evolution an acidity of 0.365 per cent HCl or over. It is, therefore, apparent that the response of the normal human stomach is not the same for the different types of foods, but the response is highly specific, revealing much higher acidities for the protein foods than for the carbohydrates.

Quite recently we studied by simple titration methods the combining powers of the various foods for simple acid solutions alone. Ehrig, Zahn and myself found that a simple glass of milk will neutralize the free acid of a mixture of 0.3 per cent HCl or more, as determined by titration with thymol blue; while 25 grams of most of the milk preparations will neutralize more than one-half of the free acid of 100 cc. of 0.5 per cent HCl. Many of the meats in 25-gram porportions will completely neutralize the free acid of 100-gram portions of 0.5 per cent HCl. Bread, likewise, has considerable combining power.

There is no reasonable doubt at the present time that there are considerable variations in the normal gastric acidity as encountered in different groups of normal persons. Some individuals show persistently subnormal responses as compared to our clinical standards, while many reveal responses above those which are considered as normal; but for all practical purposes the great majority of the human race, inasmuch as we are familiar with it, as well as the statistics in England and Australia, would seem to indicate that most individuals show a characteristic normal response and usually reveal this response on all occasions short of disease. The finding, therefore, of an altered response suggests that something is wrong with the individual, particularly if we know the previous character of his secretion. It is possible under appropriate conditions to find acid figures in health which duplicate those in disease, and, therefore,

the dictum has gone forth that no increase in acidity occurs in disease which is not encountered in health. Literally, this is true. The acid figures encountered in health under certain conditions (notably under the stimulus of meat ingestion for instance) parallel those found in disease. Comparing the Ewald-meal response, however, in health and disease, we may find a vast divergence. In other words, the significance of an Ewald meal in inducing an hyperacidity is of far greater importance than the same figure with a meat meal. With an Ewald meal, for instance, but few normal individual give hyperacid responses, and the splendid studies in England with the gruel meal substantiate this conclusion. On the other hand, in proven hyperacidity (such as encountered in duodenal ulcer, for instance), the incidence of high-acid figures is altogether different from that encountered with a group of normal subjects. Moynihan, in operatively demonstrated duodenal ulcer, found high-acid figures with the fractional meal in 72 per cent of cases, and I found it in 78 per cent of cases—figures never encountered in health and suggesting that there is present a condition known as hyperacidity.

How are we to explain, for instance, the reduction of the native high secretion to the so-called optimum commonly encountered with test meals? Undoubtedly, several factors play a rôle. The combnation of food products, the dilution factor and, not the least, the miechanism of automatic regurgitation of the alkaline duodenal contents must play a rôle. We have many suggestions today which are being subjected to the merciless scrutiny of the clinical experimenter. Ever since Boldyreff suggested that there was an automatic regulation of gastric acidity by the reflux of the alkaline pancreatic secretion, many factors of importance have been adduced as favoring this theory. Boldyreff's experiments were on dogs. Some years ago, Hawk and I, with Spencer and Meyer, studied the regurgitation of the alkaline pancreatic secretion by means of the demonstration of trypsin in the gastric contents, and were able to prove to our satisfaction that the fall in acidity in many instances was accompanied by an increase in the trypsin content of the gastric secretion. Furthermore, in the fasting stomach the tryptic content was inversely proportional to the free acid, a point which was probably explained on the basis that the pylorus was in a state of reduced tonus and more favorable to the regurgitation of the pancreatic secretion. We also proved that the introduction of the 0.5 per cent HCl was followed by a drop in the acidity of the gastric

contents and, in many instances, by a rise in the tryptic content of the secretion. Bolton and Goodhart, in a totally different way, by studying the chloride content of the gastric secretion, came to the conclusion that the neutral chloride rose as the free acid fell, and that the fall was due to the reflux of alkaline pancreatic secretion. They assumed, however, that the important point was the tonus of the pylorus, and that a relaxed pylorus by favoring regurgitation lessened the acidity, while the hypertonic pylorus discouraged this phenomenon, with the result that acid values remained higher. Pyloric tonus, therefore, played an important part in their conception, while it did not seem to occur to them that hypertonus of the antrum, or even the stomach as a whole, might as effectively bar duodenal regurgitation.

More recently, MacLean and Griffith came to a totally different conclusion. They are of the opinion that the regulation of the gastric secretion was an automatic thing largely dictated by the H-ion concentration of the gastric juice. In other words, they believe that the concentration of HCl in the stomach is regulated automatically by the H-ion concentration of the gastric juice. According to these observers, the presence of a certain concentration of the acid in the stomach inhibits the formation of acid and results in the accumulation of a neutral chloride-containing fluid which, by dilution, reduces the acidity of the gastric contents. They make the statement that whenever a fluid is taken in the stomach, this organ, by the combined effort of emptying and secretion, tends to adjust the concentration of HCl to the normal maximum level. These investigators were of the opinion that the production of hydrochloric acid was a self-limited process, and that at an arbitrary end-point near the end of digestion the acid already accumulated in the stomach in some way stops the further production of acid and provokes the secretion of a neutral chloride-rich fluid which gradually displaces the acid from the stomach by dilution. While this theory is ingenious, the experiments which these authors give are far from conclusive. If this were true, then, hyperacidity ought to be impossible, owing to the inhibition of acid in excess of optimum. Elsewhere we are prepared to answer these contentions; suffice it for the present that the theory, while attractive, is by no means proven and much of the evidence is in our opinion not convincing. Babkin, in a recent communication, calls attention to the variations in the gastric acidity, and by another altogether different

line of approach—namely, by studying the character of the various gastric glandular elements—attempts to explain the variations which occur. In particular, he calls attention to the activity of the so-called "mucoid" cells and their possible influence on the acidity of the resulting gastric secretion.

The fact remains, however, that clinically we encounter excessive acid figures under conditions which normally warrant a much lower response with a given test-meal. How, then, are we to explain these findings? Several years ago I devised a so-called gastropyloro-duodenal tube which was so constructed that the pylorus was kept

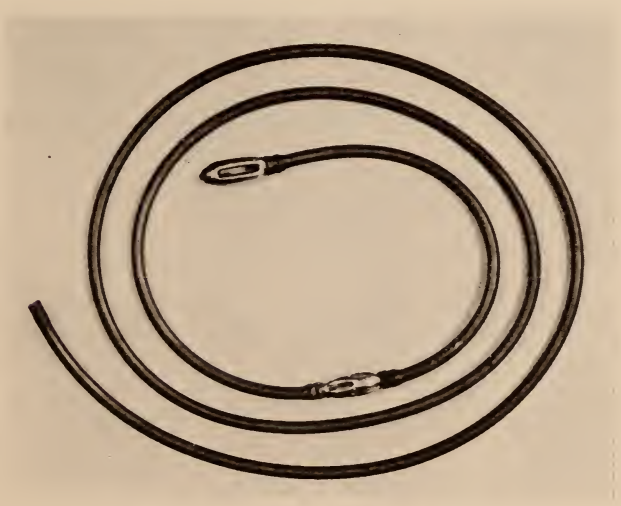

FIG. 1.—Gastropyloroduodenal tube.

more or less patulous. It consisted of a single tube the lower end of which consisted of two tips such as are shown in the illustration. The terminal tip is the same as that found in the fractional tube. Several inches from this tip another metal piece is inserted, so constructed that the lower slots enabled material from the gastric antrum to readily flow into the duodenum through the duodenal tip, or *vice versa*, depending on the relative pressures of the antrum and duodenum. The upper portion of the second metal piece is so constructed as to be totally independent of the lower portion and to enable the observer to withdraw specimens from the antrum. When this tube is properly inserted, under flouroscopic control,

the duodenal tip is in the duodenum and the upper metal piece in the gastric antrum. In proven cases of hyperacidity this tube is passed under identical conditions, using the same meal, and the resulting response studied. We reported these findings sometime ago, Dr. John Eads and myself having carried on a series of observations in demonstrable hyperacid cases. The results in a number of instances proved that such a tube, by maintaining a patulous pylorus, resulted in the reduction of the hyperacid curve to normal or subnormal figures. In several instances the result was not a reduction, a finding which we interpreted as due to gastric hypertonus as a whole, and in one instance, by careful radiographic control, we believed we were justified in this assumption.

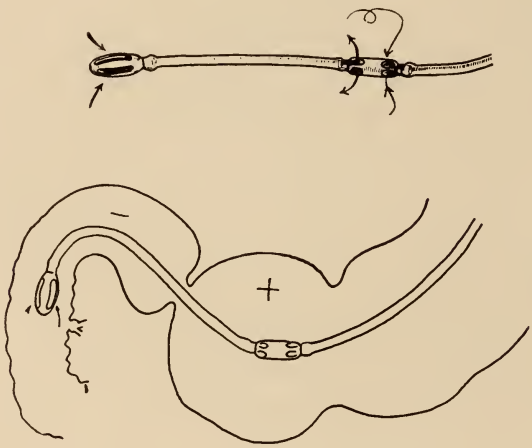

Fig. 2.—Emplacement of gastropyloroduodenal tube.

These findings, emphasizing as they did the importance of pyloric tonus, showed in almost every instance of authentic reduction in the acid curve unmistakable evidence of duodenal regurgitation, as apparent from the presence of bile. In previous experiments we pointed out that a disassociation could take place, so that alkaline pancreatic regurgitation could take place without the demonstration of bile. I was interested in noting the communication of Iwanow, on the same subject, in which he maintained that such a disassociation did occur. Iwanow, in 1926 found, as we had found almost ten years before, that the secretion in the fasting stomach, not only in achylia and hypoacidity but also in the hyperacid types, contained

trypsin. He, furthermore, pointed out, as we did, that bile was not always a true index of regurgitation and that there is no parallel between bile and pancreatic regurgitation. Hetenyi and Vandorfy, from their studies, showed that the pancreatic secretion was the first to regurgitate, the bile second and the intestinal secretion last. Ehrman and Lederer and Boenheim pointed out that even in higher acidities acid may not destroy trypsin. Iwanow was of the opinion, based on an extensive experimental study, that in the normal individual there is a periodic regurgitation of the duodenal contents representing a mixture of the pancreatic secretion, the bile and the intestinal secretion; in the fasting stomach periods of rest and regurgitation are intercalated. He was of the opinion that, perhaps, the periodic regurgitation exerted a protective antipeptic function. Furthermore, he also suggested, as we have, that in duodenal ulcer and in gastric ulcer the regurgitant mechanism may fail. The significance of this mechanism is apparent when we realize the high incidence of hyperacidity in duodenal ulcer and the attempt to produce a radical cure by devising operations which control acidity.

Dr. J. Earle Thomas, Dr. Eads and myself, in the last year, by means of a double balloon, in a specially devised tube and with graphic methods, attempted to study the movements of the normal antrum and duodenum at rest and during digestion, with healthy students. Without going into detail regarding the methods employed or the results obtained, we were able to show periods of increased motor activity, as well as increased pressure in the duodenum over that encountered in the antrum during the fasting stomach. We believe that we have been able to demonstrate intervals during the fasting stomach as well as periods during the active digesting stomach, which are conducive to regurgitation. Although our studies did not take into account the activity of the pylorus, it is altogether likely that pyloric activity is linked up with antral activity, as the work of Wheelon and Thomas on animals would indicate.

The point which I would stress is the fact that it is altogether probable that factors other than purely secretory factors are responsible for the phenomenon of hyperacidity. Certainly duodenal tonus, the tonus of the pylorus and the degree of tonus of the stomach, as a whole, are determining factors in the phenomenon of duodenal regurgitation. There is no reasonable doubt that the regurgitation of the alkaline intestinal content can, and often does,

regulate the acidity of the stomach contents. Whether it is entirely responsible or only partly responsible for this mechanism in health, we are not prepared to state; but that it does occur in health, and that it can play an important rôle both in hyperacid and hypoacid gastric states, is to be scarcely questioned from the knowledge we possess at the present day. It is apparent, therefore, that any method which seeks to control rationally the question of hyperacidity should attempt to control this factor.

DISCUSSION

Dr. J. Earl Thomas: The possibility, suggested by Dr. Rehfuss, of a regulating mechanism for the gastric acidity resident in the pyloric sphincter suggests to me just one possible objection, *i. e.*, that it puts another burden on the already overworked pyloric sphincter. Probably a good share of the mechanism of gastric emptying is to be accounted for by the motility and tonus of the gastric wall in general; certainly the sphincter alone cannot be made responsible for all of it. Probably the same thing will appear when a clearer understanding is had of the matter of regurgitation of duodenal content into the stomach.

In regard to the diagram showing peristaltic waves passing over the stomach, pyloric sphincter and duodenum: although the chart that was reproduced gives a proper picture of the qualitative alterations that occur and of the contraction time, etc., it is subject to many quantitative variations. Sometimes the gastric contractions will be the stronger, and at other times the reverse situation will occur, and I think it is really the resulting quantitative differences in the pressures in the stomach at the sphincter and in the duodenum that determine the exit of food from the stomach. At any rate, it does not always pass the sphincter with each wave, although the sphincter contracts following each peristaltic wave in the stomach. The same principle would probably apply in the case of the regurgitation due to contraction of the duodenum while the antrum is relaxed. If the acidity of the stomach is regulated by regurgitation through the pylorus, the controlling mechanism will probably be found in something that has to do with the relative degree of contraction of the several muscles involved as compared to each other.

Dr. C. W. Lueders: The vagal or parasympathetic division of the vegetative nervous system maintains the tone of the digestive tract, while the sympathetic division controls the sphincters. Carlson and Lott proved, however, that the pylorus is under the control of fibers from both divisions; so it is most difficult to learn the intricate viscerosensory and motor reflexes of the vegetative nervous system. We do know that the vagus not only maintains the tonus of the stomach and gut, but has much to do in regulat-

ing the secretions as well. The solution of the problems arising in these cases, referred to by Dr. Rehfuss, is to be found in a proper understanding of the direct and indirect action of the vagal and sympathetic fibers upon the sphincter of the pylorus, the muscular coats of the stomach and duodenum and upon the secretory glands. And just as important, reflexes coming from other organs, acting through the same nerves, *i. e.*, the hyperacidity and pylorospasm associated with gall-stones.

The pharmacological response of the two divisions, vagal and sympathetic, must also be known: how the atropine group of drugs, and calcium, depress vagal action, and epinephrine stimulates sympathetic reflexes.

Recent studies made with barium-mixed test-meals showed that in a large series of cases there occurred a reflux of barium from the duodenum in only 20 per cent of the patients. I do not believe a reflux of duodenal contents is necessary to lower the acidity in the stomach at the end of the digestive period.

Dr. Rehfuss (closing): I have only this to say regarding Dr. Thomas' remarks. I admit that all the burden cannot be put on the pyloric sphincter; on the other hand, there is a group of symptoms that belong to this category.

I would suggest to Dr. Lueders, upon the action of the sympathetic, that, he will see many such cases that are most confusing.

I am only interested in one point: How can I alter the secretion? I merely know that, if we put this kind of tube through the pylorus and keep the tube in such position and control radiographically, that we get a different type of gastric response. How you will explain it, I do not know. I know that a certain number of people have hyperacidity, and when you talk of a patient with pylorospasm, we find it in 25 per cent of gall-bladder cases and in ulcer. When I look at the screen, as I make it my business to do, with at least two or three people on almost every screen-day, I have to sit down for a while and wait for pyloric relaxation. Ask any radiologist about this. Some years ago we had an argument whether every peristaltic wave causes relaxation of the pylorus, and I said it did not. A gentleman in Boston criticized me. McClure and his associates said that with every peristaltic wave there was an evacuation from the stomach. That may be true at the height of digestion. The stomach is very susceptible to psychic phenomena. As you reach the acme of digestion the sequence of events is absolutely rhythmical, and then at every peristaltic wave the pylorus opens. If we are to solve this problem, we will do so by studying the sequence of the pylorus and duodenum. In the first series reported in Washington you will see that some of the cases, where the responses are exactly the same, the explanation is that the stomach is so hypermotile that regurgitation cannot occur. I mention these experiments because a certain number of hyperacidities are dependent upon excessive hypertonicity of the stomach as a whole.

POSTVACCINAL ENCEPHALITIS AND ALLIED CONDITIONS*

The Nathan Lewis Hatfield Lecture
Lecture IX

By SIMON FLEXNER, M.D.

(From the Laboratories of the Rockefeller Institute for Medical Research, New York.)

In 1923 I had the privilege, as Frederick A. Packard Lecturer, of addressing the College on a subject related to the one on which I propose to speak this evening as Nathan Lewis Hatfield Lecturer. Some of those in the audience which is honoring me by its presence may recall that the Packard Lecture was devoted to a consideration, chiefly from the standpoint of the pathology, of the disease called indifferently "lethargic" and "epidemic encephalitis." The effort made in that lecture was to define the disease in as clear a manner as was possible at the time, and to separate it from certain pathological and clinical complexes with which it had been brought into alliance. What was really undertaken, and perhaps accomplished, was to distinguish epidemic encephalitis from epidemic influenza, Australian X-disease, herpes virus encephalitis and even from epidemic poliomyelitis. The net result of this analysis was to present epidemic encephalitis as a clinical and pathological complex of independent nature, the etiology of which still remained undetermined.

In 1923, epidemics of encephalitis were still widely prevalent in many parts of the world and only just about to reach a maximum in England and Wales. Today the disease is less widely and less severely epidemic, and, except for our essential ignorance concerning its nature, it might be looked upon as receding and taking on the character of an endemic and sporadic malady. This change in its epidemiology is further accentuated by a modification of seasonal occurrence. When the epidemics were at their height, they tended

* Read February 6, 1929.

to reach maximum proportion in the late winter months. Today cases of the disease are encountered throughout the year.

The two questions which are still uppermost in the minds of investigators relate to the etiology and the earlier history of epidemic encephalitis. I am leaving to one side such other important matters as treatment, sequels and, in general, problems relating to the clinical aspects of the disease, because not only am I incapable of dealing with them adequately but they are so present to the mind of the clinician that I have nothing novel to bring him.

What may be called a determined effort has been made to bring epidemic encephalitis in man into relationship with herpes virus encephalitis in rabbits and even in monkeys. The main source of this effort has been the Pasteur Institute in Paris, under the influence of Levaditi. A less insistent center of this idea has been the laboratory of Doerr in Bâsle. Levaditi seeks to identify the two diseases etiologically, according to the resemblance of the inoculation lesions of the brain in the rabbit and monkey, with the spontaneously occurring lesions in the brain of man. This undertaking disregards all criteria which make epidemic encephalitis in man a so-called clinical entity, and debases the disease, as it were, to mere forms of inflammatory encephalitis of acute character, deprived of the peculiarities of clinical manifestation and the immediate and ultimate pathological effects which really distinguish it. It is true, of course, that herpes virus readily induces an encephalitis of acute or hyperacute variety in rabbits, and that occasionally monkeys of several species also can be made to respond to direct brain inoculation of this virus by acute, sometimes fulminating inflammation. There is, however, striking absence of essential conformity between these rapidly fatal infections and the whole complex train of symptoms and consequences which characterizes epidemic encephalitis in man.

A puzzling phenomenon has always been the ease with which herpes virus can be passed from herpes vesicles in man to the rabbit, and the extraordinary rarity with which it has been communicated to this animal with materials taken from the nervous system of cases of epidemic encephalitis. Recently Rose and Walthard, of Doerr's laboratory, thought that they had hit upon the explanation of the discrepancy. They found that a herpes virus strain when injected into the brain of the guinea-pig induced encephalitis and then disappeared; that is, the herpes virus encephalitis of the guinea-pig could not be passed by animal to animal

inoculation, as can that of the rabbit. In this difference they perceived, as it were, the missing etiological link uniting human epidemic encephalitis and experimental herpes virus encephalitis. They emphasized the point that in the guinea-pig, and assumedly in man, the herpes virus acts for a brief period, damages and inflames the brain and in turn disappears. Aside from the significant fact that human epidemic encephatitis is a malady in which relapse and progression are common, the explanation fails to account for the existence of strains of herpes virus of more potent qualities which behave in a quite different manner. Indeed, as soon as the guinea-pig experiment is carried out with a strong herpes virus, the outcome is wholly changed; the virus is not destroyed in the course of the inflammatory reaction which leads to encephalitis, but multiplies in the infected and inflamed brain, and is capable of unbroken, indefinite guinea-pig passage.

In like manner, competent evidence excludes streptococci and other banal bacteria as incitants of epidemic encephalitis. All such bacteriological findings may be attributed to technical errors, or at most to secondary, intercurrent infections, of which indeed the proven number is small. Our position has, therefore, remained unchanged as regards the essential causation of epidemic encephalitis. This affection, which clinically assumes numerous forms, is still to be classed with the diseases of unknown etiology.

On the side of the history and epidemiology of the disease there has been some slight enlightenment. It is now quite accepted that the group of cases arising in Vienna during the World War and described so well by von Economo in 1917, was either anticipated by a somewhat less uniform group of cases observed by Cruchet in the war zone in France in 1915 and later, or that the cases which each observer encountered arose almost simultaneously. There can hardly be a doubt that the Austrian investigator perceived the significance of the cases in a brilliant manner. Incidents which have come to light more recently point to the occurrence of sporadic cases of an indistinguishable disease in Roumania as early as 1915. What, therefore, now appears to have been the case is that in about 1915 and 1916 Cruchet in France, von Economo in Austria and Urechia in Roumania were recognizing cases of a nervous affection of peculiar clinical character, and that von Economo brought the cases he observed into a new, common category to which he applied the name of encephalitis lethargica.

This aspect of the wide early distribution of the disease is considered at length by Stern in the 1928 edition of his comprehensive book on epidemic encephalitis. Moreover, Stern has brought together chance descriptions from the works of earlier authors suggestive of the previous occurrence of sporadic and grouped cases of a nervous malady which may well fit into the symptom-complex now termed "epidemic encephalitis." In exploring this hazardous field we must keep in mind that we can expect small aid from pathology. Up to one hundred years ago, the meager pathology of the brain was embraced under the two heads of "hardening" and "softening." We are on firmer ground in weighing clinical descriptions, although, as Stern has pointed out, the term "lethargos" used in early medical writings was applied to every acute febrile affection attended by prostration and somnolence. A great stumbling-block in the path of the medical historian is found in the spectacular character of epidemic influenza and the frequency of the complications attending that epidemic disease, and the tendency to ally with it special clinical manifestations not otherwise easily accounted for. I have already dealt with this subject in the Packard Lecture, and the more recent articles, reiterating the point, have not led me to revise the views there expressed, which are to the effect that epidemic encephalitis is not to be classed with the influenzal or postinfluenzal group of infectious diseases.

The term "sleepy sickness" seems to date from Fechting's use of the expression about 1580. A century later Sydenham described, under the term "Febris comatosa," certain cases attending influenza, but as the common ocular paralyses of present-day epidemic encephalitis are not enumerated among the symptoms, no particular grounds exist for separating these cases from the common cases of "lethargos" of his day. Netter has indeed resurrected an instance recorded by Hildesheim in 1695 as a curiosity of Nature, in which a young girl suffering from fever, headache, prolonged sleep (eleven days), attended by pronounced strabismus and ptosis, made a slow but complete recovery. It is probable that the minute search now going on will reveal still other instances in which the outward signs are those of certain forms of epidemic encephalitis. This is as it should be, since if we assume that disease to be of the nature of an infection and the epidemics to be produced by the rapid passage of a specific microbe from person to person, it is highly probable that the incitant of the disease existed in earlier historical periods.

At those periods the precise conditions required to convert sporadic or endemic prevalence into epidemic outbreaks may have been less pronounced than in our time. Looking at the civilized world as now constituted, this need not be regarded as a unique occurrence. The severe pandemics of cerebrospinal meningitis and poliomyelitis of the twentieth century probably exceed in magnitude and intensity anything of the kind previously arising. We are now living in a far more populous and closely knit world than existed at any time in the past. The large, compacted population is striving with brain and brawn as never before; what is more probable, therefore, than that these new, strenuous conditions of living should be reflected in the diseases, considered in mass, from which mankind now suffers.

Postvaccinal Encephalitis.

We are now confronted with another problem in the same category. Ever since Lucksch in Prague, in 1924, called attention to cases of supposed epidemic encephalitis following antismallpox vaccination, the observed number of such coincidences has been rising steadily. Bastiaanse, indeed, observed the first Dutch instance in 1924, since which time Holland has suffered more severely than any other country, with the possible exception of England. Probably no European country has wholly escaped incidences of the sort, and a small number has been reported in the United States. The small number and sporadic occurrence of cases of encephalitis following vaccination in Europe generally and in America might have been overlooked, had it not been for the more massed outbreaks in Holland and England and for Lucksch's report. This view is enforced by the fact that now that a postvaccinal variety of encephalitis is widely recognized, cases which have arisen earlier than 1924 are being redescribed or reconstructed from examples of uncertain nervous maladies observed or reported prior to 1924. In England alone some 11 such cases have been recovered from the records of 1922; Turnbull and McIntosh observed what seems an undoubted case in London in 1912, Comby in Paris in 1905, and 3 of Wilson and Ford's cases arose in 1922, 1923 and 1924. In Germany an attempt has been made by Kaute to collect and reconstruct cases from earlier published reports and Mader has recorded a case observed in 1912.

It was Lucksch's report in 1924 that first arrested attention, although it is clear from Bastiaanse's observation, made in the same year, and the subsequent events in Holland that the Dutch experience would have aroused similar wide interest. It is worth mentioning that the two most severe outbreaks have arisen in Holland and England, two countries separated by a narrow sea boundary. No other European or American country has yielded numerous cases between 1924 and the present time.

The first impression was that vaccination somehow converted a latent epidemic encephalitis infection into an active one. That was the view of Lucksch, which he supported by autopsy and histopathological findings. Subsequently it was proven to be erroneous. It was the view, also, of Bastiaanse and other Dutch observers, as well as of Netter, who studied the first Dutch statistics. It is indeed a fact that the early Dutch cases overlapped in time with an abnormally high epidemic encephalitis incidence. However, Dutch writers soon abandoned this conception, since the incidence of the postvaccinal cases continued high and that of epidemic encephalitis veered in the contrary direction.

In general it may be stated that epidemic encephalitis was practically everywhere on the decline as the number of cases of postvaccinal encephalitis rose to a maximum. Hence the connection of the two nervous maladies seemed improbable on epidemiological grounds alone; as we have now learned, the affections are distinguished sharply by the clinical course and by the histopathological findings.

English and Dutch Epidemics. The English and Dutch experience with postvaccinal encephalitis far exceeds that of other countries, and most of our detailed knowledge of the disease is derived from the studies made in those two countries. The studies cover the essential features of the clinical course, histopathology and epidemiology, and we shall do well to follow them in our exposition. It chances that the limited studies carried out in other countries are in essential agreement with the experience of the English and Dutch.

The British report covers the years 1922 to 1928 and totals 93 cases, and the Dutch report the years 1924 to 1928 and totals 150 cases. Neither report is complete. The Dutch add 50 cases arbitrarily, as of more indefinite clinical character and therefore

missed, and the English make no effort to complete the number arising on conjectural grounds. It is, however, significant that at the present time (summer of 1929) cases continue to be reported from England. The cessation of reports from Holland is probably explained by the official discontinuance there of vaccination for one year, while the disease is being studied as completely as is possible.

In what follows immediately, the disease postvaccinal encephalitis will be considered from the standpoints of clinical manifestations, histopathological character and epidemiological features. The chief original papers on the subject and some excellent reviews are now readily available. My personal experience is based on the microscopic examination of specimens kindly sent me by Dr. Ledingham, of the Lister Institute, London, including sections from Perdrau's case, and of specimens secured through Dr. McCoy, of Washington, of a typical case, to be referred to later, from East St. Louis, Illinois. The net results of my study of the literature and the microscopic examination of the tissues may be given in this place, and are to the effect that postvaccinal encephalitis is a disease-complex of striking individual nature, in the sense that it presents a consistent pathology, using that term in a wide sense, clearly separable from epidemic encephalitis, although it may prove to bear resemblance to the form or forms of encephalomyelitis which arise occasionally in the course of the exanthematous affections of childhood and in connection with certain rare cases of other infections in both children and adults.

Clinical Manifestations. The two immediately arresting features of postvaccinal encephalitis are its hyperacute course and its high fatality. The mortality among the assembled English cases is 50 per cent, and among the assembled Dutch cases 35 per cent. The difference of 15 per cent may readily be explained by the inclusion in the Dutch figures of a greater number of mild cases and their omission from the English figures.

There is still another feature of the disease which ultimately arrests attention, namely, that recovery when it takes place tends to be complete. This outcome is independent of the stormy course and alarming character of the disease at the onset, and is in striking contrast with the end-result in cases of epidemic encephalitis of all grades of severity.

The clinical course is usually a rapid one and death occurs or

amelioration sets in within one or two weeks. In view of the fact that cases of postvaccinal encephalitis are being reported rarely in the United States, it may be of value to present in brief form the common clinical characters of the malady.

The onset of the nervous symptoms is abrupt and rarely gradual. Hyperacute symptoms are commoner in infants than in older children and adults. Prodromata including headache, vomiting and pyrexia arise, but the tendency is for more impressive, distinguishing and alarming symptoms to supervene quickly. The English regard the three prodromata given, plus paralysis, to be the cardinal symptoms of postvaccinal encephalitis. In infants, again, convulsions involving one or both sides of the body are rarely wanting; in older children and adults convulsions are less common and may even be absent altogether from groups of cases. In hyperacute cases consciousness is quickly lost, the temperature rises to an alarming height, profound prostration and paralysis set in, and death may occur in from two to four days. Older children and adults who escape the intense manifestations develop paralytic effects involving one or more members of the body and attended inconstantly with meningism. Not only are the extremities paralyzed, but parts also supplied by the cranial nerves, so that paralysis of the face, eyes, speech and deglutition arise. The reflexes usually disappear and the Babinski sign is irregularly present. The functions of the bladder and rectum are disturbed, leading either to retention or incontinence. The occurrence of trismus has led to confusion with tetanus and the administration of tetanus antitoxin, and tremor and choreiform movements have been described.

The cerebrospinal fluid is under increased pressure, and except in severe and fatal cases in which mononuclear cell excess and presence of protein have been noted, it tends to be normal and has always proven sterile.

The vaccination process has been described as progressing normally, although in certain instances it has been stated to be severe. No distinctive rash attends the other symptoms.

The severity of the onset and the course are not reliable guides to prognosis. Extensive paralyses disappear and abolished reflexes return in a short time. The duration of the acute disease is usually from one to two weeks, irrespective of recovery or death, but protracted cases have been described as exceptions, although it has not

always been made clear whether complications arose, prolonging the usual duration. Pette gives as the distinguishing characteristics of postvaccinal encephalitis the hyperacute onset, evanescence of the severe symptoms when recovery occurs, tendency for the restoration of function to be perfect, although in rare instances mental deterioration or residual paralysis follows.

Histopathology. It is not remarkable that the first fatal cases of postvaccinal encephalitis were mistaken for epidemic encephalitis attending antismallpox vaccination. And yet the gross appearances of the brain and spinal cord bring out distinctions. While congestion of the meninges was a constant finding, punctiform hemorrhages and areas of softening in the brain and spinal cord have also been noted, and they are conspicuously absent in cases of epidemic encephalitis.

The lesions as disclosed by the microscope are more impressively distinct. A mere cursory examination of the basal structure of the brain reveals infiltrative lesions which may be confused with the corresponding lesions in epidemic encephalitis, but a complete histological study of the brain and spinal cord provides a basis of differentiation. Complete studies of this sort led McIntosh and Turnbull and Perdrau in England, Bouman and Bok in Holland, and Pette in Germany to the formulation of histopathological changes characteristic of postvaccinal encephalitis, which with certain allied affections already alluded to are being classed under the designation of "diffuse encephalomyelitis."

As compared with epidemic encephalitis, in which the lesions are nearly always confined to the brain and chiefly to the basal gray matter with much rarer involvement of the cortex and white matter, postvaccinal encephalomyelitis is an affection in which both brain and spinal cord, and both the gray and white matter of each, are implicated, and in which the white matter is attacked by preference.

The characteristic type of lesions in epidemic encephalitis is proliferative and infiltrative, and the increased cells are supplied chiefly from the microglia. The characteristic type of lesion in postvaccinal encephalitis is degenerative, exudative and proliferative. The first of these leads to areas of apparent softening, in which a process of demyelinization of varying extent has taken place. The second and third are brought about by accumulations of cells in communica-

tion with the demyelinated regions, in which the bloodvessels participate strongly. These vessels show rings (cuffs) of small cells, limited chiefly to the outside coats but sometimes invading this sheath, connected with which are similar infiltrations penetrating in a gradually diminishing degree the surrounding parenchyma. The infiltrating cells are composed of proliferated neuroglia cells and possibly endothelial cells, exuded plasma cells and polymorphonuclear leukocytes. Where actual disorganization is going on, compound granular corpuscles are met with; and while in these places the finer axis cylinders are lost, the coarser ones withstand the destructive process. When the disease has endured sufficiently long reparative are associated with the degenerative changes, and here microglial activity comes to be pronounced. The ganglionic nerve cells participate but little in the destructive processes and neuronophagia is rarely seen.

As regards the distribution of the lesions it may be stated that the leptomeninges, aside from congestion and pin-point hemorrhages, are affected but slightly, although occasional foci of combined lymphocytes, plasma cells and endothelial cells are met with. The brain and cord are diffusely affected, often without particular choice of locality, though not everywhere with the same intensity. White and gray matter are involved impartially, and no particular system shows involvement more than another. On the whole the cerebral cortex is often spared, and the lumbar region of the spinal cord is more commonly the seat of severe lesions than are the cervical and dorsal parts. Certain cases have shown progressive increase in severity of the lesions extending from the cervical to the lumbar cord. The basal structures of the brain are widely affected, including the substantia nigra, in which the lesions may be disproportionately severe.

We are thus permitted to measure the pathological conditions arising in the brain and spinal cord upon which the clinical signs and course of the disease rest, and to speculate on the remarkable phenomenon that, with lesions so widespread and severe in fatal cases, such complete functional restoration takes place in those that recover.

Bouman and Bok in Holland and Pette in Germany have called particular attention to the histological resemblance of the nervous lesions of postvaccinal encephalitis with those of the diffuse encepha-

lomyelitis arising from certain miscellaneous infections of adults, and also, if rarely, of younger persons.

Epidemiological Features. This aspect of postvaccinal encephalitis can be dealt with at this time in a tentative fashion only. And yet the cases which have so far appeared in numbers, and even cases arising singly, have shown features which lend themselves to consideration from this point of view. At the outset any careful observer will find something in the events of the past five years or so to give him pause, in view of the decades during which mass vaccination has been carried out on a world-wide scale without a remotely corresponding series of nervous complications having appeared. That the events are not wholly without parallel is shown by the fact that Comby has recalled a probable case occurring in 1905, Turnbull and McIntosh, and Mader have reported a case each arising in 1912, Kaute's supposed cases observed between 1912 and 1927, Wilson and Ford's cases, and the dozen English cases of 1922. Taking into account the fact that all or nearly all of these cases have, as it were, been reconstructed so as to fit them into present-day knowledge, we are led to believe that other cases, not yet revised or wholly misinterpreted as being connected causally with vaccination, must have arisen. It is even probable that certain cases have been wrongly diagnosed as tetanus following vaccination, and this danger should be kept in mind when future cases capable of this erroneous interpretation come to notice. All this leaves us unenlightened as to why, between the years 1922 and the present time, the cases of nervous complications of vaccination should have increased in numbers and in extent of their distribution. Bijl's suggestion that general vaccination is a kind of artificial mass epidemic, which like other epidemic maladies arising naturally may be attended by complicating secondary diseases, fails to explain the phenomenon because it fails to account for the lack of the complication prior to 1922.

Perhaps one of the most significant incidents of postvaccinal encephalitis is the regularity of the time interval between vaccination and the onset of the nervous symptoms. If we call this interval *incubation period*, we shall find that the English and Dutch groups, with which the isolated cases of other countries conform, are in this respect remarkably uniform. The correspondence is brought out by the following tabulation:

TABLE I

Interval in days between vaccination and onset of nervous symptoms.	Dutch cases.	English cases.
2	...	2
4	...	2
5	1	
7	3	4
8	4	1
9	6	2
10	19	11
11	30	23
12	30	23
13	12	12
14	6	2
15	2	1
16	1	
17	3	1
18	2	1
19 to 34	4	3
Total cases	123	87

What is immediately striking is the strong tendency for the nervous manifestations to declare themselves between the tenth and thirteenth, and especially on the eleventh and twelfth, days after vaccination. The English reports indicate that the outlying cases, or the ones arising on the second to the fourth and the twenty-third to the twenty-sixth days, were in infants. This fact, if it is true in general, carries its own interesting, if still uninterpretable, meaning, because the indications are that infants up to the second year of life are relatively insensible to the postvaccinal nervous malady. Thus far the countries in which vaccination is widely resorted to in infancy have reported few and only sporadic cases of the postvaccinal nervous affection. This seems to have been the case in Germany as in the United States, and in the latter country the cases reported center around the sixth year, although Wilson and Ford report one case at two years of age.

The English and Dutch figures and the occasional reports from other countries agree in pointing to school age as being the period of greatest susceptibility. I interpret school age, since the wide introduction of the kindergarten, as extending from the third to the sixth years, which are also the ages at which the largest number of cases has been reported as showing the severe nervous affection. There are two definite age-periods at which most vaccinations are performed: one is in infancy and up to the second year, and the other at school age, a somewhat more variable period. In England, as in

the United States, most vaccinations are made in infancy; in Holland at the school age. The United States seems to have escaped so generally the postvaccinal disease, and such few cases as have been reported center about school age, that the relative frequency may be conjectured to be alike in all these countries. Some contributing factor, however, is more commonly or widely effective in England than in the United States, although the operation of this factor is highly irregular, not to say haphazard. Concentration of vaccination and incidence of the encephalitis do not go hand in hand. Certain counties in England displayed high incidence, and yet the analysis of cases of encephalitis arising among the vaccinated from one to fifteen years of age, during the 1923 epidemic, showed for these counties an incidence of 1 to 800, as compared with an incidence of 1 to 1100 in England and Wales as a whole. The disparity as shown in Table II for the ages of seven and eight years for Holland may be due to the somewhat later school entrance in that country.

Table II.—Age Incidence in Holland and England

Holland.		England.	
Ages.	No. of cases.	Ages.	No. of cases.
0 to 1	1	0 to 1	9
1 to 2	1	1	3
2 to 3	7	2	..
3 to 4	34	3	1
4 to 5	27	4	1
5 to 6	37	5	1
6 to 7	15	6	5
Over 7	1	7	11
		8	12
		9	5
		10	6
		11	6
		12	8
		13	5
		14	3
		15	4
		Over 15	14

There is one other nonconforming incident to be observed in the table. In Holland the cases stopped abruptly with the seventh year; in England they still arose exceptionally up to the fiftieth year. Hence there is no sharp age limitation of susceptibility. Here again mere differences in practice determine the result. English law and custom permit vaccination to be long deferred. Hence in a time of danger from smallpox, many adults are vaccinated. The cases reported among adults in England may also include revacci-

nated persons. Gildemeister has given attention to this point. No mention has usually been made whether in the revaccinated the primary vaccination was successful. In the one instance coming to Gildemeister's attention, scars of a previous successful vaccination were absent.

Finally, in England two-thirds of the vaccinations are performed during the first year of life, and this age period yielded 9.8 per cent of the cases of postvaccinal encephalitis recorded. The remaining one-third of the vaccinations taking place at school age yielded 85 per cent of the nervous cases. No case was noted in an infant under six months of age. Mader, of Frankfort a/M., does, however, report a case at six months of age. Terburgh, of Holland, has compiled certain figures, numerically tentative, bearing on age incidence as affected by the number of vaccinations. They show that 79 per cent (98 out of 124) of the cases occurred in the third, fourth and fifth years of life. The following table is based on Terburgh's data:

TABLE III

Under 1 year	1 case postvaccinal encephalitis to 27,405 vaccinations
2 to 3 years	1 case postvaccinal encephalitis to 22,407 vaccinations
3 to 6 years	1 case postvaccinal encephalitis to 2,586 vaccinations
About 6 years	1 case postvaccinal encephalitis to 2,209 vaccinations

The foregoing does not exhaust the epidemiological data supplied by the recorded cases. We may group together other incidents of at least present interest, although future experience may alter their apparent significance. Contagion has played no part in producing cases either among the vaccinated or nonvaccinated, and seasonal effects are wholly wanting. This is in contrast to the history of epidemic encephalitis, in which contagion is believed to play a part, if only a subordinate one, and seasonal influence was originally strongly indicated. On the other hand, multiple cases have arisen in households and small communities. They have always been among the vaccinated and usually have arisen simultaneously. The English described this event as "simultaneous series of explosions quite unconnected;" in view of the fixed incubation period, this is what would be looked for. A suggestion of family disposition is seen in the occurrence of two cases in children vaccinated respectively in 1923 and 1925. In England, females have been attacked about twice as often as males, 62 cases giving a ratio of 1 to 2. The largest annual number of recorded cases is 51 for England in 1923.

Holland recorded 40 in 1925, 35 in 1926 and 50 in 1927. During the recent summer months (1929), 7 fatal cases have been reported from England. Doerr estimates that about 400 cases have been reported in the past five years and thinks the number understates the actual occurrences.

Etiology. Up to now we have been on pretty solid ground in our explorations. Our next steps must, I fear, be taken on less secure terrain. Indeed, we are about to enter territory in which conjecture and hypothesis often take the place of confident observation.

Perhaps this situation need not be regarded as disheartening. The unravelling of pathological complexities is often a laborious process. After ten years of intensive study we are still ignorant of the immediately causal nature of epidemic encephalitis. Our plight will become discouraging, I think, if we adopt a too ready or simple explanation of the etiology of postvaccinal encephalitis.

Two or three lines of conjecture have been followed in the effort to explain the recent numerous cases of the disease. Vaccine virus itself has been thought of as the offending agent; or vaccine virus, introduced into the skin by vaccination, has been accorded the power to rouse into activity a second microörganism already present in the body in a state of latency. Finally, something etiologically indicative has been attributed to the fixed incubation period of about ten to thirteen days after vaccination. This is the period during which antibody formation reaches a maximum. Hence Glantzmann and others have suspected that the first action of the vaccinia virus is to sensitize nervous tissue, after which, at the height of antibody production, reaction occurs, this reaction being allergic or anaphylactic in nature, producing therefore a kind of "shock" which ushers in the encephalitic process. This view is highly artificial and it encounters serious obstacles at the outset, one of which is the relative rarity of the process, considering the frequency of vaccination. Another is the failure of so general a biological phenomenon to appear during the previous hundred years when antismallpox inoculation has been steadily growing in volume. There is nothing distinctively different in vaccinations as now made from those carried out before 1922, and yet by general consent, cases of postvaccinal encephalitis, very rare before, have become disturbingly frequent since that date. No one virus or even several viruses have been responsible for the change, since these strains have been in use many years. The neurotesticular vaccine of

Noguchi and Levaditi has received wide employment in Spain at least, where, as far as is known, no cases of encephalitis have arisen among the nearly 3,000,000 persons on whom it has been used. When the Spanish rabbit strain was employed in Holland, nervous complications followed as with the bovine strains.

The hypothetical latent virus has not received definition beyond the supposition that it is not of bacterial or even of visible nature. The favorite point of view is that synergistic or coöperative action takes place between two ultramicroscopic organisms, one being vaccine virus and the other a potential morbific virus, latent in the body, and roused into pathogenic power by the vaccination. Until the histopathological findings dispelled the possibility, Levaditi and his associates regarded the herpes virus as the second malevolent agent. The hypothesis of latency meets also considerable obstacles. Aside from its rather sudden appearance, it must be conceived to possess the extraordinary qualities of wide dissemination over the world and yet of capricious activity. The entire notion of latency and activation seems quite gratuitous, inasmuch as no such synergistic process is known to pathology. Animal inoculations carried out with nervous tissues and cerebrospinal fluid have so far yielded no results of a distinctive nature supporting either the activation or other theory of causation.

That vaccine virus itself may under extraordinary circumstances act as the provocative agent of encephalitis has been held by McIntosh and Turnbull and irregularly by other pathologists. It is true that McIntosh and Turnbull were successful in two instances, using a special technique of enrichment, in recovering vaccine virus from the brains of fatal cases. The method of Ohtawara, based on Noguchi's testicular cultivation, does suffice to recover minimal amounts of vaccine virus from tissues, as does the method of cataphoresis recently perfected by Olitsky and Long, which separates it from tissues even when admixed with immune bodies.

We may expect, therefore, the occasional demonstration of vaccine virus in the brains of fatal cases of postvaccinal encephalitis, and it becomes necessary to determine the interpretation to be put upon the finding. The tendency is to consider antismallpox vaccination as a local process. In fact, as observations on man indicate and experiments on animals prove, it is a general infectious disease with, however, as a rule a single local lesion (vaccine pustule). Occasionally, as in *vaccinia generalisata*, the lesions become wide-

spread and numerous. After vaccination the virus may be recovered from the upper respiratory mucous membrane, and Gins and his associates who have recently restudied the condition experimentally have found virus, after skin vaccination in rabbits, in the blood, internal organs and buccal mucosa from the second or third to the tenth day after the inoculation. The mere presence of vaccine virus in an internal organ does not indicate a local pathogenic effect. It is worth mentioning that *vaccinia generalisata* is not attended by nervous symptoms.[1]

The brain of the rabbit is resistant even to the direct injection of vaccine virus. It is only after adaptation by organ-to-organ passage that it becomes effectively pathogenic. The response, then, is of the nature of a stormy encephalitis, fatal in a few days, in which the lesions are more meningitic than encephalitic, and of an acute (leukocytic) character. The neurotesticular vaccine, such as produces these effects, may be made to localize in the viscera when large quantities have been injected into the veins of rabbits. Ledingham and Barratt have just summarized and described the results of such intravenous inoculations, from which it appears that while the inner organs generally are the seat of vaccinal lesions, the brain is not. The central nervous system tends to escape focal lesions from generalized vaccinia, even when the skin, mucous surfaces and internal viscera are widely affected. It appears, therefore, to possess a protective power which the other organs possess in less degree. If we may cite the analogy of poliomyelitis, then the protective mechanism may be considered to be the choroid-plexus meningeal complex which is effective in excluding from the brain and spinal cord remarkably large quantities of the virus of that disease. It may also be able to exclude vaccine virus in a similar manner. This power is something which direct experiments can determine.

So far as known data can be interpreted with probability, vaccine virus is not the specific incitant of the encephalitis which attends vaccination. With the exclusion of this material, the etiology of the disease is left unsolved. Whether the human condition can be

[1] In a personal communication Dr. C. P. Rhoads has informed me of two rabbits in which neurotesticular vaccine, after intradermal inoculation and particularly severe skin lesions, induced pronounced nervous symptoms on the sixth and eighth days, leading to death. The animals became ataxic, hypersensitive and salivating. The histopathological changes consisted of an extensive meningoencephalitis with perivascular involvement. Gross vaccinal lesions were not observed in the other internal organs.

reproduced in animals is still undermined. It arises in man once in several thousand vaccinations; unless, therefore, accident intervenes, or some more certain method of evoking it experimentally is discovered, the search for the causation is not likely to be a brief one.

So few cases of postvaccinal encephalitis have been detected in this country that I am inclined to present the history of one such undoubted case, portions of the nervous system of which I had the opportunity of studying. The case was reported originally by Fulgham and Beykirch, with the autopsy by Harris, from St. Mary's Hospital at East St. Louis.

The child was aged six years, healthy, and had not been previously vaccinated. The vaccination was performed on December 1, 1928, the skin abrasion being superficial and about $\frac{1}{8}$ inch long. On December 8, a normal vesicle was present; the vaccination area had enlarged somewhat by the 10th, and the inflammatory area was increased. The temperature fluctuated from 99° to 102° F. The temperature was normal on the 13th, corresponding to diminution of the local inflammation. But during the night from the 13th to the 14th, headache became very severe and photophobia was complained of. On the 15th the temperature was normal, but the headache persisted, and there was incontinence of urine. The neck became stiffened and the reflexes exaggerated. No paralysis and no convulsions occurred, but mental lethargy was noted. The reflexes disappeared on the 16th and unconsciousness set in. The cerebrospinal fluid was not under pressure and showed 13 cells per cubic millimeter. Kernig and Babinski signs were negative. One convulsion occurred soon after admission to the hospital on December 17. Coma became deeper, the temperature rose to 107° F., and death occurred on December 18. The autopsy showed a congested brain without exudate in the meninges. A thick emulsion injected subdurally into rabbits produced no effect. Brain substance rubbed into the scarified skin of rabbits also produced no vesicles or other reaction. Microscopic examination of the brain (spinal cord was not removed) showed perivascular cellular infiltration. It was this brain tissue which through the kindness of Dr. McCoy of the U. S. Hygienic Laboratory and the physicians reporting the case, I had the privilege of studying. Weigert's and other stains showed definite attenuation of tissue about bloodvessels of the brain, to be interpreted probably as areas, moderately severe, of demyelinization attended by cellular infiltration, such as has already been described.

Allied Conditions. The frequent occurrence of encephalitis during the present decade has directed attention to this inflammatory state accompanying a variety of infectious diseases and processes. We have already examined in detail such a sequel to antismallpox vaccination, and it remains merely to point to the increasing reports

of myelitis and encephalitis, separately or combined, in such diseases as measles, varicella and variola, to mention only those most commonly found in the recent literature.

There is, in fact, nothing essentially new in this connection or coincidence of degenerative and inflammatory conditions of the spinal cord and brain as part of the course taken by the exanthematous and other infections. We owe indeed to Westphal the designations, now so frequently employed to define the nervous affections we are considering, of disseminated myelitis and disseminated encephalomyelitis, coined as early as 1872. There is, however, little doubt that the significance and relatively common occurrence of these accompaniments of general infectious diseases in man have come to be increasingly recognized in recent years.

For our part we can pass over the nervous complications of varicella of this order, because the cases which display them usually go on to recovery, so that the histopathological basis remains undiscovered. The lesions of variolous myelitis or encephalomyelitis have been described by Eichhorst and more recent writers; and they agree more or less closely with the disseminated foci which Pette among other recent investigators has emphasized in connection with certain general infections, and which he and others would bring into relationship with the lesions of multiple sclerosis. The immediate source or incitant of the distributed foci is unknown and one can only speculate whether they are due to the action of a primary or a secondary microbic agent or even chemical substances, inasmuch as similar lesions arise in carbon monoxide poisoning. Their importance is increased also in view of the paralytic lesions, attributable to myelitic processes, occurring sometimes in the course of or following on antirabic inoculation. All these effects are infrequent, although we possess but few actual statistical data concerning them. The 2 instances of variolous myelitis described by Eichhorst arose among 904 cases of smallpox observed by him from 1884 to 1912.

There is, however, one exanthematous disease, namely measles, in which nervous effects arise as a sequel, usually after the fading of the rash, with what appears to be greater frequency. And yet the wide prevalence of this malady may readily account for the numerical difference. Perhaps the greater interest in acute nervous affections in general explains the mounting reports of encephalomyelitis as an attendant of measles.

One of the earliest of these cases to be reported is that of Barlow

in 1887, and he was fortunate in the choice of title which was "Early Disseminated Myelitis." Ford, of the Johns Hopkins Medical School, has recently collected the cases and added 12 of his own, and Wohlwill has described the minute histopathology of 2 cases of his own. Musser, of Tulane University of Louisiana School of Medicine, has also described a case in which punctiform hemorrhages were numerous. Through his courtesy I was enabled to study sections of the brain of this case. The various reports published leave no doubt that the lesions present in the brain and spinal cord of postmeasles encephalitis correspond not with those of epidemic encephalitis, but rather with those of postvaccinal encephalitis. Their histopathology is that of a combined degenerative, inflammatory and reparative process affecting the perivascular and other tissues of the white and gray matter. Myelin destruction leading to attenuation of structure, lipoidal waste products taken up by phagocytes, glial proliferation and even lymphoid-cell infiltration all occur. The axis cylinders resist destruction in large part, and actual degeneration and loss of ganglionic nerve cells are small. That considerable, if not complete, restitution is capable of taking place is indicated by the prognosis, which for life is good, although residual effects are far more common than in postvaccinal encephalitis.

The decade through which we are passing has shown an increase in the number and variety of myelitic and encephalitic affections. In part this is attributable to outbreaks of epidemic or lethargic encephalitis, and in part accounted for by what appear to be unusual attendances of antismallpox vaccination, measles and other infections by inflammations of the central nervous organs. To our present knowledge of clinical and histopathological features it is hoped that knowledge of the directly inciting events may come also to be added.

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THE TREATMENT OF ABSCESS OF THE LUNG*

By GEORGE P. MULLER, M.D.

(From the Surgical Division, Hospital of the University of Pennsylvania.)

To those interested in thoracic surgery, the treatment of abscess of the lung has an interest only secondary to the removal of chest tumor. The object of this paper is to present the results following operation in a small group of cases, observed in the Hospital of the University of Pennsylvania (Surgical Division B) during the period from January, 1922, to January 1, 1928, and to try to describe the reasons for success and failure in the treatment of a very difficult disease.

Abscess of the lung describes a localized suppuration in the lung with or without gangrene and with or without a localized (lobar) bronchiectasis. Massive gangrene and diffuse bronchiectasis are not included. I have excluded a few cases of cancer of the lung with central suppuration. An excellent description of the pathologic aspects will be found in the paper by Aschner (1922), who had the opportunity of studying specimens from a number of lobectomy operations performed by Lilienthal.

A chronic cavity partly filled with pus emptying into a bronchus periodically, and with walls lined by granulation, is the common type of abscess. Sometimes the walls are necrotic and the cavity contains a foul lump of tissue; this may be considered as gangrene because massive gangrene of the lung is rare, fortunately. As the result of pressure, bronchi may dilate and the entire system of a lobe become the seat of suppurative bronchiectasis, or an adjacent lobe may become involved, but diffuse bronchiectasis of the entire lung or of both lungs is not so common unless congenital in origin. Again, a foreign body may plug a bronchus and infection plus stasis and dilatation results in bronchiectasis. If one bears in mind the pneumonitis in the lung surrounding the actual lesion and the col-

* Read March 6, 1929.

lapse sometimes attendant upon a plugged bronchus, the roentgenologist can usually diagnose the exact condition of affairs and the method of procedure then becomes apparent.

I cannot see the great importance in the plea made by Kline[1] for a differentiation between abscess and gangrene, particularly when he bases the difference, apparently, upon an examination of the sputum. He states that abscess is caused by pyogenic organisms, usually the staphylococci, reaching the lung by aspiration from the oral cavity or through the blood stream from a distant focus of suppuration. He believes it to occur more frequently in children than in adults. Gangrene, on the other hand, occurs more frequently in adults and is caused by a group of organisms (notably spirochetes, fusiform bacilli and vibrios) aspirated from the oral cavity. He believes the differentiation can be made by the sputum.

It is true that this sputum examination is of great importance because the finding of the spirochete-fusiform organisms does suggest the use of arsphenamine as part of the treatment, as he says, but beyond this it indicates a more rigid search of gums, teeth, tonsils and sinuses for foci of infection. Beyond this the determination of an area of gangrene means nothing distinctive from the treatment of abscess because, in my experience, gangrene means a cavity with gangrenous walls sloughing into the cavity, and drainage is indicated just as in pyogenic suppuration. In fact, pyogenic organisms are usually found concomitant with the others.

If we thoroughly discussed the method of infection of the lungs after tonsillectomy there would be no space for the consideration of any other phase of the subject. A brief résumé may be worth while, however. About the time that tonsillotomy was being discarded in favor of complete removal, including the capsule, Richardson (1912) called our attention to the occurrence of lung abscess after tonsillectomy. In France, Bassim (1913) reported a series of pulmonary complications after tonsillectomy, some of which were suppurative. Manges (1916) reported 9 cases in adults. Many other cases were added, and the general opinion prevailed that the inspiration of septic material, especially when a motor-driven apparatus was used for anesthesia, was responsible for the infection. The possibility of blood-stream infection was considered, but it was believed to be the cause in a relatively small number of cases.

[1] Jour. Am. Med. Assn., 1928, xc, 2008.

TABLE I.—TONSIL GROUP. 13 CASES (37 PER CENT)

Average age	29 years
Below 15 years	2 cases (15.4 per cent)
Average, before onset	10 days
Average, before operation	7 months (12 cases, 4.5 months)
Operation mortality	8.0 per cent
Final mortality	23.0 per cent
Cure (to 1928)	63.5 per cent

But later the pendulum began to swing to the other extreme. Simpson and Noah (1922) reported 2 cases and stated their belief that more cases occur as a result of hematogenous infection than is generally supposed. Fetterolf and Fox (1923) were able to show from animal experiments that a septic thrombus can form in the throat after tonsillectomy. They did not produce lung abscesses, but believed that this septic thrombus could produce abscess. They called attention to the blood spitting after tonsillectomy as being indicative in some cases of an infarction in the lung. After extended observation over a number of years, Cutler (1920) began calling attention to the fact that postoperative pneumonia was not principally due to the irritation of inhalation and aspiration, but rather was embolic in origin. This led to the idea that abscess of the lung might have a similar etiology, and Cutler, together with his coworkers, Weidlein, Holman and Schlueter, began the splendid series of experiments which definitely established that abscess of the lung can be produced in dogs by the use of small infected emboli.

Turning to the aspiration origin, it has long been known that during anesthetization some of the buccal content is aspirated into the lung. This has been proved experimentally by the use of dyes by Hoelscher (1898) and others. Myerson (1923) found blood bronchoscopically in 76 of 100 cases after tonsillectomy. This aspiration occurred in spite of the fact that he employed most of the usual devices, such as posture and suction, to prevent the entrance of the mouth contents into the trachea. Similarly, Daily and Daily[1] found blood in 78 per cent of 100 patients bronchoscoped. They also examined 3 cases operated upon under local anesthesia and blood was found in the lungs and esophagus of one of these. Iglauer[2] also bronchoscoped 100 children immediately after tonsillectomy and found blood in the trachea or bronchii in 40 per cent.

[1] Texas State Jour. of Med., 1927, xxiii, 277.
[2] Annals of Otol., Rhinol. and Laryngol., 1928, xxxvii, 231.

Of much greater interest to me is the clinical investigation which they carried out on 50 adults after tonsillectomy performed under local anesthesia. The tonsils were anesthetized by injecting procain, cocaine not being applied in order to exclude any possible anesthesia of the pharynx and larynx. The patients were operated upon in the upright position and were encouraged to expectorate any blood which collected in the mouth. As soon as the bleeding ceased the larynx and upper trachea were inspected with a laryngeal mirror and it was found that 19 (38 per cent) had blood in the trachea. While the normal cleansing mechanics of the tracheobronchial tree must be considered in relation to these experiments, yet Iglauer very properly observes that patients should refrain from making any forced movements of the throat after tonsillectomy and by suppressing the cough reflex favor the retention of aspirated material.

Mullin (1926) called attention to the relation of paranasal sinus infection to disease of the lower respiratory tract. While primarily concerned with bronchiectasis, he makes the pertinent statement that infection may extend from the sinus to the interbronchial glands and the resultant enlargement of these glands may produce cough and pressure. Graham (1928) very recently has stated that he often sees spontaneous healing in advanced cases of chronic pulmonary suppuration merely after the correction of the suppuration in the nasal sinuses, especially in the case of children. Crowe and Scharf (1928) have produced abscess of the lung in dogs after introduction into the frontal sinus of a piece of cotton soaked with fresh scrapings from a pyorrhea cavity in a patient. Finally, I must mention the work done by Smith (1927). He produced pulmonary abscess in mice, guinea-pigs and rabbits by the intratracheal inoculation of material from the alveolar border of the teeth of pyorrhea patients. He collected cases from the literature showing no difference in the case of those which were postoperative or those due to other causes, and, further, found that these anaërobic organisms were not present in 150 cases of uncomplicated pulmonary tuberculosis. Smith makes another interesting point. He did not see an abscess manifest itself before eight days after the introduction of the material into the lung, and generally ten or twelve days elapsed before definite abscess occurred. He thinks this indicates that the abscess goes through a pneumonic stage before breaking down.

The above-mentioned reports seem to me to be the most important

contributions, but of course there have been many others. We are left somewhat in a position of uncertainty as to whether in a given case the infection has reached the lung by way of the bloodvessels, by aspiration, or even by the lymphatics through the route described by Mullin. As Jackson (1926) says: "It is not impossible that two or even three routes may be traveled in the case, as might occur when an infective agent reaching a bronchus has penetrated the epithelium. Once this barrier is passed, the blood and lymph channels are reached, and a relatively remote parenchymal focus might result."

As a result of this intensive investigation certain practical points stand out clearly. Patients should not have tonsillectomy performed when active suppuration is present in the sinuses nor until pyorrhea has been cleared up. The latter condition occurs particularly in adults and I have been impressed by the fact that 85 per cent of the posttonsillectomy lung abscesses in my series have occurred in patient over fifteen years of age, many of whom had carious teeth and diseased gums. During the operation, the head should be kept low and constant aspiration used until bleeding has ceased. Jackson believes that ordinary aspiration of the pharynx should be supplemented by aspirative cleansing of the laryngopharynx and orifice of the larynx by means of the direct laryngoscope. Fetterolf suggests that needle-carried sutures for tying bleeding vessels be abolished and surface ties used instead.

Let us turn for a moment to a brief consideration of the larger group (60 per cent) of lung abscess which do not follow any type of operation. As has been stated, in 13 of my series the origin of the abscess apparently was the result of a tonsillectomy, the onset of cough with expectoration following shortly, three weeks being the longest time and five days the shortest. In only one case, a man aged sixty-three years, was there the history of a previous chronic bronchitis and he also had an attack of hemoptysis one month before the tonsillectomy. In one case the abscess followed operation for ruptured spleen, and another, a child of fifteen, developed symptoms six months after the extraction of teeth. One patient had a fibroid tuberculosis in which the pyogenic abscess developed. It was not a tuberculous cavity. Of the other 19, I would judge that 8 (26 per cent) followed an attack of lobar pneumonia, 3 followed bronchopneumonia, 4 had chronic cough for many years, over 20 in all, and in 4 the etiologic factor was obscure.

The development of abscess in an area of unresolved pneumonia is easy to understand if we presuppose a secondary invasion by pyogenic microörganisms. In those patients with chronic bronchitis over a long period, and in those who have suffered damage to the lung from bronchopneumonia, it is probable that a combination occurs of low lung resistance and chance aspiration from mouth or nasal sinus, especially when spirochetes and fusiform bacilli are present. King and Dacey (1928) found spirochetes and fusiform bacilli in large numbers in most patients with chronic pulmonary suppuration. Lowering of lung resistance would be favored by impairment of cilia action and impairment of the cough reflex, by arrest of the normal drainage from cough because of occluded bronchi from fibrous tissue. It may be that trapping of the special organisms by a plug of mucus activates the infection and determines the occurrence of abscess.

A recent study of cases of supposed unresolved pneumonia by Pickhart (1928) contains some information of value in this connection. In follow-up roentgenograms of the cases of true unresolved pneumonia taken from sixteen months to four years later he found a constant lesion, expressed as a peribronchial infiltration and thickening due to increase in the connective tissue, localized in the formerly consolidated area. He found the picture similar to that seen in a chronic bronchitis except that in the latter condition it is found generalized throughout the whole bronchial tree. I note from his table that in one case of influenzal bronchopneumonia there was advanced peribronchial infiltration three years five months later. It is apparent that infection can easily take effect in such lungs.

I do not see how we can conclude that abscess in those who have not had operation is due to other causes than aspiration, except in the rare case of emboli from thrombosis. For awhile I inclined to the embolic theory in the postoperative group, but now favor aspiration as a method whereby the lung is infected in practically all cases of the "nonoperated" group and most of the postoperative group for the following reasons: (1) the experimental work recently done by Smith, Crowe, Allen and others shows that abscess can follow aspiration as well as embolism; (2) the investigations of Cutler and others have justified the opinion that most postoperative pneumonias are embolic, and hence abscess should follow operations on the stomach and gall-bladder as frequently as after tonsillectomy,

but it does not; (3) while pain, cough and bloody sputum at onset are not a necessary feature of lung embolus, yet they should occur frequently if embolus was the usual factor. The complex is rare, however. I suspect that the reason for the frequency of the post-tonsillectomy abscess lies in the frequent aspiration of blood, as shown by Myerson, in addition to the infecting microörganisms. The experiments of Allen (1927) in connection with empyema are comparable. No doubt some abscesses follow embolism, but they are mostly the less-common gangrenous type. My experience does not agree with that of Kline (1928), who regards pulmonary gangrene as a frequent lesion in adults.

In my series the lobes were involved as follows:

	All cases.	Post-tonsillectomy.
Right upper	14	5
Right lower	9	5
Left upper	3	1
Left lower	9	2

One patient in whom I drained a right upper-lobe abscess showed a left lower at autopsy. Another with abscess of left lower had a second collection in the right lower lobe. These second collections are not included in the above table. I believe it is generally acknowledged that the location is not important as an argument for either aspiration or embolism.

Prognosis. The mortality following operation for lung abscess is quite high, and perhaps necessarily so by reason of the serious nature of the disease. In my own experience the mortality of all cases dying in the hospital after operation was 10 deaths in 35 patients (28.6 per cent). These figures represent a fairly good result because in many of the reported series it is higher. Lockwood (1922) finding it to be 34.6 per cent in a collected series of 1117 cases; Whittemore (1923) has reported excellent results in a series of 52 cases with 8 deaths (15.4 per cent).

It seems to me that one of the reasons for the present high mortality is the delay that ensues between the onset of symptoms and the diagnosis and the too-prolonged treatment by insufficient drainage methods. Chronic cough and expectoration should always be considered as sufficiently suggestive to lead to a careful physical examination and a roentgen-ray visualization of the chest, particularly if the symptoms have followed an operation on the upper air passages or a pneumonia. Several of my patients were diagnosed

as tuberculous and sent to a sanitarium, where the correct diagnosis was made. It is significant to note that 42 per cent of the series had hemoptysis. Many of the patients were given some medical treatment, or attempts at postural drainage over a period of time, but postural drainage to be effective must be done thoroughly and efficiently and can be effective only if the patient is coöperative. Frequent use of the roentgen ray will show how effectively the method is acting. Lord (1928) cured 22.6 per cent of his cases by rest and postural drainage when the duration of the illness was eight weeks or less. Graham (1927) believes that 25 per cent or more of abscesses near the root of the lung will heal spontaneously without any treatment. Various other figures are given in the literature, the most recent that I have seen being those of Berry (1929), who states that more than 55 per cent of the cases seen at Bellevue Hospital on Miller's service have been cured by postural drainage.

TABLE II.—MORTALITY STATISTICS

	All cases.	Tonsil groups.	Others.
Total	35	13	22
Deaths	10	3	7
Per cent	28.6	23	32
Total average age	34 years	29 years	44 years
Fatal cases	47 "	29 "	55 "

Average age, 36.3 years.	Cases.	Deaths.	Mortality.
36 years or less	19	3	16.0 per cent
Over 36 years	16	7	44.0 "
Mean age, 35 years.			
Below 35 years	17	2	12.0 "
Over 35 years	17	8	47.0 "
Over 50 years	8	5	62.5 "

The surgeon himself may be responsible for the mortality if he does not make a proper selection of the procedure, operates during a stage of acute pneumonitis, does too much to a weakened patient, uses ether anesthesia, etc. A long and careful preparatory treatment is essential.

Secondary abscess in the other lung is usually fatal. Hemorrhage, cerebral embolus and acute pyopneumothorax are nearly unavoidable complications which add to the mortality. About 10 per cent of the cases develop malignant affections in the lung. As broncho-

scopy is usually done by skilful operators no comment is required except to note that, in my experience, it occasionally promotes a bronchopneumonia.

The age of the patient has a definite bearing on mortality, as shown in my cases: 27 patients were under fifty years of age, with 5 deaths (18.5 per cent); whereas, in those over fifty, there was a mortality-rate of 62.5 per cent. Lilienthal (1928) mentions the factor of age in his series, the mortality being 42 per cent in those under fifty, and 63 per cent above that level.

Treatment. The treatment of lung abscess necessarily must vary with the type of the disease, but it must be apparent that drainage of the cavity or cavities is the essential principle. If we bear this in mind there should be little controversy as to whether this is accomplished through the air passages by postural drainage, by means of bronchoscopy, by compression with artificial pneumothorax or through an external opening made by the surgeon. Each of these has certain value and certain limitations. It is difficult to formulate hard-and-fast rules to govern each case. Everyone will acknowledge that there is an essential difference between an abscess which is draining into the bronchus freely, the patient being nearly afebrile, and one in which drainage is not good and the evidence of gangrene manifest by the foul odor of the expectoration and the occurrence of marked fever and rapid pulse. An abscess near the hilus is better situated for conservative treatment than one well out on the periphery. A peripheral abscess, especially if single, is easily reached and drained by thoracotomy and by reason of its long sinus will rarely heal by other treatment. A marked bronchiectatic area with multiple cavities will not be cured by any means short of eradication by operation.

A patient presenting the symptoms of lung abscess should have a careful roentgen-ray study and a bronchoscopic diagnostic examination to eliminate foreign body and determine whether or not pus is draining. He should be kept in bed, given high-caloric feeding, heliotherapy if available, and taught postural drainage. In those cases in which the bronchoscopist thinks treatment advisable, weekly treatments are given. As a rule this group will comprise those abscesses near the hilus, but even in cavities further out and in bronchiectatic cases the suction of tenacious plugs of mucus and pus materially helps postural drainage.

Bronchoscopy has a very definite and important place in the

treatment of lung suppuration. In all cases the advice of the bronchoscopist should be sought, and, if he is willing to attempt treatment, it should be given a trial. Except in the occasional case, one notes the improvement as being manifest distinctly after two or three treatments. Only rarely have I observed a spreading pneumonitis as a result of the trauma of the bronchoscope.

The advantages of bronchoscopic treatment have been brought forward forcefully by Kernan (1928), who has reported 68 cases with 45.5 per cent of cures; 27 followed tonsillectomy with 55.5 per cent of cures. Kramer (1928) reports that 27 per cent of 105 patients were cured. Clerf reports 51 per cent of cures in the posttonsillectomy abscess, but had 79 per cent of cures when treatment was started within three months of onset.

The nasal sinuses should be examined and drained if necessary. Arsphenamine may be useful when the expectoration is fetid and spirochetes are present in the sputum, but too much must not be expected from its use. In cases where the abscess is centrally located, draining freely and comparatively recent, artificial pneumothorax may be worth while. I note in a recent report by Whittemore and Balboni (1928) that they attempted artificial pneumothorax in 18 cases of lung abscess with 2 cures (11 per cent); there were 3 deaths during treatment, from hemorrhage from the lung; adhesions were present in all 3 cases; empyema occurred 5 times, with 3 cures by drainage and 1 death. They conclude that the method is questionable as an ideal treatment for abscess, but is more favorable for bronchiectasis.

Blood transfusions should be given to the anemic patient, and it is well to heed the warning of Jackson regarding the use of sedatives for cough, as these favor stagnation when we want a draining lung.

In the case of central abscess, near the hilus, when the bronchoscope has established drainage, it is probable that operation will never be indicated, and at any rate these patients may be allowed to go for many months under postural drainage and bronchoscopic aspiration. The danger of hemorrhage after thoracotomy is too great except in the exceptional case. On the other hand, peripheral abscess is so easily handled by external drainage that prolonged waiting is not justifiable. Even if the abscess drains and the patient is relatively afebrile, the chronicity of the process will tend to increase fibrosis to such an extent as to cripple the lung. Hence I believe that four months should be the limit for waiting for apparent

cure by methods other than thoracotomy. One caution must be given and it cannot be given too strongly: We should make every effort to avoid operating until any pneumonitis in the lung has subsided; when the roentgen-ray picture shows the entire side of the chest as a cloud, you can be sure that the entire lung is in a state of mild or severe suppurative pneumonitis and little good will be accomplished by draining the cavity at this time.

I might put this in another way by quoting from Miller and Lambert (1926): "There is a period in lung suppuration when the alveoli in the immediate vicinity of the abscess are collapsed but the respiratory epithelium is still intact, and they are, therefore, capable of reaëration and this is the most favorable time to operate. If the suppuration continues, this epithelium disappears and the alveoli are obliterated, and there is found a true connective-tissue layer composed of fused alveolar walls, observed in chronic abscesses —a condition most unfavorable for a complete cure and one which favors the establishment of a permanent bronchial fistula."

Lilienthal (1928) questions the above point, stating that he does not see how we can determine which cases of acute abscess will become chronic. He believes that progressive gangrene and suppuration cannot be permitted to go on without some attempt to check their progress, even though the operative statistics would suffer.

Only occasionally will we be able to effect a cure by nonoperative methods in the case of the multiple-cavity abscess or in those with a marked degree of bronchiectasis associated with the cavity. Such patients will require early thoracotomy for preliminary drainage and later will need to have multiple cautery operations done after the method of Graham.

It is not necessary to digress upon the technic. I use local anesthesia whenever possible. Occasionally some gas must be added. We remove a section of one rib for a small abscess quite close to the periphery; for others, and especially in the case of multiple cavity, two or three ribs are removed. Gauze saturated with mercurochrome solution is packed against the parietal pleura and the flap closed. Under ordinary circumstances the second stage is done five days later and after removing the gauze and thoroughly washing the wound the cavity may be entered with the cautery and the abscess evacuated. The exact location of the abscess must be determined by roentgen-ray views in three directions if this approach is to succeed in practically all cases.

In the after-treatment every effort should be made to increase the patient's weight, but as long as there is the slightest evidence of fever he should be kept in bed. The persistence of a bronchial fistula is not harmful and no attempt should be made to close it. Sometimes we have packed the cavity with gauze at operation and sometimes have drained it with soft tubes; but at any rate these need to be removed in three or four days, and by means of suction and gentle cleansing the wound can be so improved that in two weeks' time it presents a clean, granulating area plus the bronchial openings. In mild cases without bronchiectasis the latter will soon close, but when a bronchial fistula persists it is best to have post-operative bronchoscopy done in the hope of being able to remove granulations or to dilate strictures. The bronchoscope can be used, also, as a means of preventing recurrent abscesses. In the case of lung abscess the bronchi neighboring on the cavity are in an inflammatory state, with impairment of ciliary activity. This encourages stagnation and may be the cause of the development of new foci, abscessal or bronchiectatic. Postoperative bronchoscopic aspiration may be indicated, therefore, in certain cases.

End-results. In the group of cases herein reported the end-result of operation is known in every case: 10 cases were considered as operative deaths because they died in the hospital; 2 of the patients while making satisfactory recoveries were seized with manifestations of cerebral abscess and died therefrom; a third patient, quite ill, only had a resection of the rib under local anesthesia preparatory to the usual drainage procedure, but succumbed on the day after operation; 4 patients were found at autopsy or by roentgen-ray to have an abscess or abscesses in the opposite lung; 1 old woman of seventy-five had a multiple gangrene of the skin of the extremities, indicating some embolic condition; in only 2 cases did it seem as though the operation itself was directly responsible for mortality.

Four patients died after discharge from the hospital. The first death occurred eleven months later from "pneumonia" and there was evidence that there was a continuation of the suppurative process; a second patient, aged sixty years, died six months later, presumably from continued suppuration of the lung; the same may be said for another patient who went into the middle west and died six months later with continuance; the fourth patient was discharged improved but with suspicion of a secondary abscess on the opposite

side; he died suddenly, two months later, from a cerebral complication.

Eight patients are considered as improved in the sense that they still have cough with expectoration or an open sinus; 5 of these patients were operated upon during 1928 and presumably some will soon be well; 13 are considered cured, 30 per cent of the whole or 52 per cent of the recovered cases. These patients have no cough or expectoration, no embarrassment of respiration, and are able to go about their work or other duties as before. Many have been subject to roentgen examination and chests are clear.

Table III.—End-results. 25 Cases. Follow Up. One Year or More

	All classes.	Tonsil group.	Others.
Final mortality	48 per cent	37.5 per cent	53.0 per cent
Improved	12 "	0	17.5 "
Cure	40 "	62.5 "	29.5 "

In view of the fact that 10 of these patients have been operated upon one year or less, I have included in the above table only those patients whose condition we know at the end of at least a year. In speaking of mortality, we laid emphasis upon the age group and in the end-result the same influence is of account; for instance, in the cured cases, the average age was thirty-two years; whereas those who died or were improved only, it was forty-five years. It will be noted that in the tonsil group 62.05 per cent were cured, whereas in the others only 29.05 per cent were cured; but the average age in the tonsil group was twenty-nine years as against forty-four years in the others.

It seems to me, therefore, that the end-result of treatment for lung abscess depends usually upon the factors of age, development of a chronicity of the lesion in the lung, the amount of bronchiectasis and the niceness with which the various therapeutic procedures are carried out.

DISCUSSION

Dr. Hobart A. Hare: Being an internist I have no intention of discussing surgical abscess, but I would ask if the reader of the paper has any information to give in regard to the bacteriology of the pus removed from these various abscesses? That seems of obvious importance, the more so as the bacteriology of pus may have a good deal to do with the ultimate result, and again because of a recent paper written by a man in Washington

whose name slips my memory at this moment. He made the very extraordinary statement that in patients with pneumonia in the city of Washington, about 90 per cent were streptococcic in origin. He pointed out that was in strange contrast to Philadelphia and New York, where about 90 per cent were due to pneumococcus. I would suppose that pus produced by this organism might have a very different bearing upon the case than pus obtained from pneumococcus.

Another point which I would like to call attention to, which is not exactly germane to the subject under discussion, is the frequency with which abscesses of the lower lobe just above the diaphragm cause fixation of the belly. I have seen diagnosis of appendicitis made in such a case.

A third point I would like to refer to was touched on very thoroughly by the reader of the paper, but I do not think is duly considered by the average operator, that is the matter of cleanliness of the mouth. From my observation over a long period of years, though much care is taken as to asepsis locally, remarkably little care is taken in regard to making the mouth aseptic. Even when several days' time elapse before operation, very little is done to really diminish the number of pathogenic organisms in the mouth.

Dr. Clerf: I wish to congratulate the essayist on the excellent results gained in his cases of abscess of the lung. In our experience the best results by bronchoscopic treatment have been obtained in those cases of abscess complicating tonsillectomy. In my series of 58 cases the complete recoveries totaled over 50 per cent. This, very naturally, seems high when compared with Dr. Kramer's results. It must be recalled, however, that he included all pulmonary abscesses irrespective of etiology, including malignancy of the bronchus. Treatment early in the disease exerts a favorable influence, as shown by statistics. Oral hygiene is extremely important, although it is often overlooked in the routine treatment of these cases.

Dr. John H. Gibbon: The Chair said that he was very much interested in Dr. Muller's communication. One of the things that struck him about these cases of pulmonary abscess was the large number that was treated for other conditions, particularly tuberculosis, before a correct diagnosis was made. A second point in which his experience coincided with that of Dr. Muller, was the occurrence of abscess of the brain secondary to lung abscess. In a collection of 29 cases made by Dr. Flick at the Jefferson and Pennsylvania Hospitals, there were 3 deaths due to abscess of the brain following pulmonary abscess. He thought that wide-open drainage and the avoidance of tubes greatly lessened, if it did not prevent, postoperative bleeding.

Dr. Muller (closing): I cannot answer Dr. Hare's question in a satisfactory way. Practically all of these patients had bacteriological studies of the pus and the sputum, but after working over the statistics I could not make any conclusions regarding morbidity or mortality from a particular organism. We had very few cases with spirochetes and fusiform bacilli in

the abscesses, although many had these in the mouth. Klein, recently, states that one can diagnose between abscess and gangrene by examination of the sputum, and he states that gangrene is far more frequent in his experience than abscess. It seems to me that is not an efficient way to make a diagnosis. On the other hand, in our series of empyema cases, I have found the mortality of the streptococcus group is far above that of the pneumococcus.

In regard to the question about drainage: At the second stage of the operation, I introduce the cautery and open up a large hole. This may be stuffed with gauze or drained with a soft rubber tube. I try to get this drainage out rather rapidly, but a short rubber tube is introduced just into the cavity, and through this cleansing of the abscess is done. I never allow the patient to go without a drainage tube as long as any appreciable secretion is present. It may be three, four or five months before we take the tube out finally and let the wound close.

CAUSES OF MORBIDITY AND MORTALITY OF OPERATION FOR GALL-STONE DISEASE*

By JOHN B. DEAVER, M.D.

The early stage of gall-bladder disease is regarded as a general metabolic disorder in which the liver plays a prominent rôle. This early stage is most often seen in young women coming to operation for symptoms of gall-stone disease after a more or less recent pregnancy. The gall-bladder of such a patient is usually normal in appearance and its bile is sterile. Bile stasis within the gall-bladder is another early stage of the disease. Either of the two is the forerunner of infection which, as I have constantly maintained, is no doubt due to the irritation caused by the presence of stone and obstruction to the free flow of bile. The bacteria brought to the gall-bladder from the liver or from the blood stream fail to be carried off by the bile, which remains more or less stagnant. Here, then, we have the interplay of liver and gall-bladder function and pathology. The effect of prolonged disease of the biliary system is, furthermore, seen in the phenomenon of dilatation of the right heart and myocardial weakness. The fact that there is an excess of bile in the blood without an accompanying cholesterol increase indicates involvement of the liver cells. This is, furthermore, shown clinically by signs of portal engorgement which eventually must interfere with the general circulation, leading to dilatation of the right heart with secondary passive congestion. If the process remains unchecked, repeated congestion causes the liver cells to lose their activity and we have cirrhosis dominating the picture. These facts, baldly stated as they are, furnish food for thought in connection with the morbidity and mortality of operation for gall-stone disease.

The question whether the gall-bladder or the liver is primarily responsible for the consequences of gall-stone disease is an important one. Some investigators believe that liver involvement is, as a

* Read, March 6, 1929.

rule, the first step. However, this is not universally true, if we are to believe the findings of workers such as A. L. Wilkie, who, in his experimental work on rabbits, clearly demonstrated cholecystitis as an entity capable of occurring independently of liver involvement. By separating the gall-bladder from its liver bed and interposing a small portion of the great omentum, shutting off all lymph and bloodvessels in connection with the liver, and injecting streptococci intravenously, Wilkie produced cholecystitis when the cystic duct was and when it was not ligated. On the other hand, when rabbits who had not been previously operated were injected, cholecystitis together with involvement of the surrounding liver substance resulted. This work, with that of Rosenow, Reimann, Graham and others, proves that infection of the biliary tract takes place through the gall-bladder and through the liver. Basing my conviction on the evidence of reports from the Lankenau Research Laboratory on the bacteriological and pathological study of numerous specimens, I am convinced this is exactly what we surgeons find in our autopsies *in vivo* in liver and biliary-tract disease, to which I refer in this discussion.

Furthermore, it is our experience that removal of the gall-bladder gives its best results where the liver is found practically, if not entirely, normal to inspection and palpation; while where the liver is more or less diseased, the ultimate results are not so good, and a certain percentage of patients fail to be relieved by operation. Removal of the chronic interstitially diseased gall-bladder, the most frequent type of the disease, in the presence of a diseased liver merely breaks the chain of a vicious circle.

A matter of primary interest is the indication for operation. The difference of opinion between the internist and the surgeon in this regard, I believe, constitutes one of the main factors in the subject under discussion. It would have been interesting and valuable, if time had permitted, to have collected the opinions of some of our prominent internists as to how many of their patients they refer to the surgeon and at what stage of the disease they do so. Leaving acute cholecystitis out of consideration, I have no doubt that the consensus of opinion would be "not until conservative treatment has proven ineffectual," without mentioning the time element. Some might qualify their statement by saying, "not until the discomfort becomes unbearable." The question, however, should be considered from the social, economic, as well as from the pathological standpoint.

On the whole there are few, especially among the large middle class, who can afford the more or less disability and expense that prolonged medical treatment entails. I believe I am safe in saying that there is no difference of opinion as to the necessity of prolonged treatment, including a careful regimen in these cases. I fully realize, also, the difficulty of controlling the patient's mode of living, especially among the less intelligent classes; this, no doubt, accounts for a large group of cases that fail to get well by any mode of treatment. On the other hand, the cures obtained by conservative treatment are more often than not temporary, as proven by a recrudescence of the trouble. Moreover, spontaneous absorption of gall-stones is a pious thought, fathered by the wish, and should it take place, some fragmentary concretions would inevitably remain to form the nucleus of later stone formation, so that in all likelihood the patient's later condition would be worse than his earlier one.

In the earliest stage of gall-stone disease, if primary in the gall-bladder, the stage of metabolic disturbance, the disease does not extend beyond the cystic duct. In other words, it attacks only the mucosa of the gall-bladder and the cystic duct remains unobstructed. In these cases medical treatment, especially nonsurgical biliary drainage, should be promising when associated with the proper regimen including rest and diet directed toward altering the blood chemistry. Unfortunately, however, the disease usually resides in the walls of the gall-bladder and it is only by removing the gall-bladder itself that the process can be checked and the ravages of continued infection prevented, such as cholangitis, hepatitis, hepatic abscess, pancreatitis, cardiac and renal derangement, etc. This is my answer to the question as to the stage of the disease when the patient should be referred to the surgeon. Two, or at the utmost three attacks of gall-stone colic should settle this point.

Of course, I know that many will make the mental reservation that surgery does not always prove successful. I quite agree with them. But why does it not, in spite of good surgical technique? Here is the answer.

From the follow-up observations in the Lankenau Clinic we find that, of the patients who fail to be entirely relieved within two years, 59.5 per cent give a history of two to twenty years of digestive trouble and attacks of gall-stone colic; while 40.5 per cent give a history of one to two years. Let us review a few of the pathological findings at operation in some of the long-standing cases.

(2633/21) Preoperative history, twelve years; common duct obstruction by stone; peripancreatic lymphangitis.

(3478/20) Preoperative history, twelve years. Emergency operation in an acute attack. A spontaneous duodenal fistula had formed; adhesions found involving stomach, duodenum, liver and colon; appendix acutely inflamed.

(916/21) Preoperative history, five years. Dense adhesions involving the gall-bladder and the liver; enlarged nodes along the common duct; head of pancreas enlarged and hard. This patient was well for thirteen months after operation. When seen again one year later (twenty-four months after operation) she complained of pain and swelling over the site of the liver and was slightly jaundiced.

(1118/21) Preoperative history, six years. Neck of gall-bladder adherent to common duct; gall-bladder opaque and thickened; hepatic flexure of colon adherent to liver.

(2473/21) Preoperative history, eighteen years. Cystic duct partially occluded by stricture; many faceted stones present.

These cases were selected at random. While on the whole they are typical, I am sure I could have found numerous other ones with more extensive pathology to worry the surgeon at the operating table, to say nothing of the worries of the patient before and after operation. The only consolation the latter has is that without operation he would have been either much more miserable or else would have been transported to the bourne whence none return.

It is scarcely reasonable to expect a cure where there has been such extensive disease. This is all the more to be regretted since it is, to a large extent, avoidable.

From the surgical point of view the most regrettable cause of postoperative morbidity is failure to remove the diseased gall-bladder or remove the gall-bladder, drain the common duct and determine the potency of the papilla of Vater; if it is not perfectly patulous it should be dilated. Contracture of the papilla of Vater by inflammatory edema, stricture, calculous obstruction, tumor, etc., may result not only in back pressure of the bile, but of the pancreatic secretion as well. Retention of pancreatic secretion, in turn, may cause focal necrosis of the pancreas, such as occurs in a small percentage of cases of so-called catarrhal jaundice that do not clear up in a comparatively short time. Therefore, change in the papilla may be one of the causes of catarrhal jaundice and of histological changes in the pancreas. Of course, in acute cases, the conservative operation is rational, but in the absence of such or other contraindications, radical surgery should be the chosen procedure. There may

be some patients, few and far between, however, who will not consent to have their gall-bladders taken out. They have a perfect right to refuse and also are welcome to keep on being threatened with recurrent attacks of gall-stone colic and all its consequences. On the other hand, there are some surgeons who still adhere to the conservative method of the early days of gall-bladder surgery when cholecystectomy was considered a difficult and formidable operation. They have the questionable satisfaction of contributing liberally to recurrent cases. Whether or not stones are actual recurrences or new stone formations or a stone has been overlooked, is not so important as that they occur most frequently after a cholecystostomy.

Recurrence of gall-stones and persistence of symptoms after cholecystectomy, is another matter. The latter, especially, can be traced directly to delayed operation. For example, while stones may be, but rarely are, secondary to cholangitis, in most instances the reverse is true, in that prolonged calculous infection leads to a cholangitis, which, as we all know, is stubborn, troublesome and dangerous, requiring prolonged surgical drainage and a strict dietary and hygienic regimen. I have drained the common duct as many as three different times in one patient. Each time I removed many minute stones mixed in with muddy, dirty-looking bile. At the last two operations, after clearing the hepatic duct and its primary branches with a scoop, I irrigated the duct. Since the last operation, five years ago, the patient has remained perfectly well.

It must be remembered, also, that gall-stone disease oftentimes affects surrounding organs besides the liver, causing a chronic pylorospasm, peptic ulcer, pancreatitis, as well as cardiorenal derangement. Indeed, gastroduodenal involvement is very frequently associated with gall-stone disease, demanding still further surgery, mainly gastroenterostomy. More serious, because less amenable to treatment, is pancreatitis, either as a primary surgical complication or as a postoperative phenomenon. If at the primary operation the peripancreatic glands and the head of the pancreas are found affected, persistence or recurrence of symptoms is to be expected, although a prolonged and careful postoperative regimen may prevent serious trouble.

The presence of such changes makes a complete cure doubtful. It also raises the question of radical *versus* conservative surgery, the answer to which will depend, to a great extent, on the degree of

pathology. Marked hepatitis and marked cholangitis, as well as marked pancreatitis, may be handled by making either a cholecystoduodenostomy or a cholecystogastrostomy after the stones, if present, have been removed from the gall-bladder; however, common-duct drainage with a T-tube is the better procedure. In passing, I would say that in neither of the anastomosis operations does the new stoma remain permanently patulous, except in the presence of complete occlusion of the common duct. Furthermore, the cholecystoduodenal anastomosis is a delicate operation and in the hands of the less experienced surgeon presents the danger of a subsequent duodenal fistula, so that the gastric anastomosis is the safer of the two procedures. On the other hand, as long as the gall-bladder remains *in situ*, reformation of stones is likely to occur, even where the gall-bladder has been anastomosed.

As a not infrequent cause of postoperative morbidity, chronic pylorospasm should always be looked for and corrected. It is our practice to remove the anterior half of the pyloric sphincter, and our results have been satisfactory. While making the Rammstedt operation is better than not doing anything, removing the anterior half of the sphincter offers better and more permanent results.

Postoperative adhesions, although not uncommon as a cause of morbidity, do not play the rôle so often attributed to them. This can be best exemplified when operating for stone in the common duct in the presence of extensive adhesions. In these cases better results are obtained if it is possible to remove the stone without separating the adhesions. I believe recurrence of symptoms, so often attributed to adhesions, is more often due to chronic pylorospasm. However, the adhesions should be released, but the pylorus should not be overlooked.

Fistulous communication between the gall-bladder and usually the duodenum, and occasionally with the hepatic flexure of the colon, may be a remote cause of morbidity. In either instance, but particularly when the communication is with the colon, infection of the liver will ultimately occur, causing a symptom-complex almost impossible to recognize except by sight and touch.

The most frequent causes of postoperative morbidity and mortality are some form of chronic disease of the liver, the result of a latent infection not easily recognized as such and not subjected to operation at the most opportune time when looking and acting would accomplish more than watching and waiting to see what will happen. The

chronic liver is seen as either a circumscribed or a diffused fibrosis, a cholangitis or a solitary abscess.

Circumscribed fibrosis is more common in the right lobe and more marked near the site of the gall-bladder. It is manifested by white streaks on the surface, increased consistency, rounding or thinning-out of its anterior border, some enlargement of the lobe, especially fore and aft, and, in some instances, the presence of a circumscribed, boggy, edematous condition. When the left lobe enters into the picture there is usually an accompanying enlargement and fibrosis of the spleen. Diffuse fibrosis, fortunately, is not so common a finding, but when seen comparatively early is readily recognized by the size and consistency and the thick, rounded anterior border of the liver. Occasionally a hydrohepatosis is seen and is usually associated with involvement of the common duct. I have known this to be so pronounced as to make the outlook seem most uncertain, but had the satisfaction of seeing it clear up after several weeks of drainage of the common duct.

A large and important aspect of our subject is common-duct involvement, a complication practically always due to gall-stones or their sequelæ. Stone in the common duct is rarely a primary affair. With few exceptions, biliary calculi originate in the gall-bladder. When I operate for stone in the common duct I feel sorry operation was not made before the stone left the gall-bladder. Involvement of the common duct, therefore, is the result of more or less prolonged gall-stone disease. Such involvement may also lead to stricture of the common or of the hepatic duct or of the papilla of Vater, and to regurgitation of duodenal contents (after operation) upon the duct, the result of loss of function of the muscle of Oddi, due to prolonged obstruction of the duct. Stones or any other of these complications add materially to the seriousness of biliary pathology, both clinically and surgically, and are potent factors in the morbidity and mortality of gall-bladder surgery. As far as calculous obstruction of the common duct is concerned, one simple reason for persistence of symptoms after operation is the fact that one can never be sure that all stones or traces of stone have been removed from the bile ducts at the first operation. While it is possible for stones to form in the ducts after a cholecystectomy or a choledochostomy or both, it is a safe guess that recurrent attacks of typical gall-stone colic after these operations are due to stone overlooked at the primary operation.

From a surgical point of view there is, perhaps, no region in which accidental trauma is so easily inflicted as the common duct. Surgery upon this duct requires a clear exposure, a sharp feather-edge dissection and a bloodless field. Also the details of searching for stone in the common duct are delicate to the extreme and the effects on the body of manipulations in this region, as pointed out by Crile, are comparable to the effects of manipulation on the spinal cord or the brain. Then, also, there is the effect on the liver function caused by draining the common duct, and the sudden decompression of bile in a jaundiced or recently jaundiced patient. The toxic effect of jaundice on the entire system needs no discussion. We all know that it means a tendency to bleed, as well as hepatic and renal insufficiency. Again, I am obliged to say that this complication is to a large degree avoidable by early attention to cholecystitis and its associated phenomena.

Not all cases of postoperative morbidity in biliary tract disease, however, are due to actual recurrences. Neurosis contributes largely to this class of cases. Although imaginary ills to the complainant hurt as much as real ones, they aré neither so easily nor so successfully treated. There are, no doubt, many people who enjoy poor health. What to do with such I gladly leave to the neurologist, the psychiatrist and the psychoanalyst.

Now as to the surgical mortality of gall-stone disease.

In the Lankenau Clinic the most common cause of death is cardiovascular disease, acute dilatation, embolism and coronary thrombosis. Whether or not acute dilatation is an entity is questioned by some of our able internists; but in spite of these opinions we know it occurs. Most cardiac deaths occur in heavy, obese women in whom, doubtless, the deposit of fat about the heart acts as an additional factor in a heart that, in most instances, is already attacked by myocardial weakness. In these cases we derive very little satisfaction from digitalis. In our experience, small doses of morphine, given at regular intervals, are much more effective. Do what you can, and say what you please, these obese patients increase the weight of our responsibility.

Pneumonia stands very low in the list of causes of postoperative deaths. This is at least partly due to operating under intraspinal anesthesia, which enables the surgeon to work rapidly and with greater ease, which of course in turn means less risk to the patient; diathermy, also, is a great factor in reducing the incidence of postoperative pneumonia.

So-called liver shock, spoken of by many writers, we rarely if ever see. We agree with Crile, that shock is due to faulty preoperative care and failure to use diathermy during the operation. Diathermy is our stand-by in all serious abdominal operations. As remarked by Miss Rapp, our chief anesthetist for many years: "Doctor, your diathermy patients are not sweaty and depressed as they were before we used this means of maintaining, as well as increasing, the bodily temperature." Maintaining the temperature of the liver and the bodily temperature in heavy abdominal operations is most important and can be best obtained by the application of diathermy not only during the operation, but, in some instances, for some hours after operation. We have found it very advantageous, for example, in chronic cholangitis of some standing with profound jaundice, after a drainage operation to apply diathermy constantly for two to three hours daily. There is no other organ whose depressed function so affects the entire system as that of the liver. It is, therefore, essential to take advantage of such liver functional tests as are at our disposal, and bring liver function as near to the normal as possible before operation, and to avoid depression during the operation by using intraspinal anesthesia and keeping the entire field warm by the use of diathermy externally and hot gauze pads within the abdomen. The systemic effect of hepatic disease or surgical trauma is sufficiently explained by the nerve supply of the liver. Lying, as it does, within the center of the sympathetic system, with its network of nerves and ganglia close to the cœliac plexus, this intricate plexus is necessarily affected by anything that affects this intraäbdominal area, including, of course, the gall-bladder, whether by a disease process or operative trauma, or postoperative contact with drainage or adhesions. If, as Crile well says, the cœliac plexus is the abdominal brain, then the liver can be called the abdominal medulla.

In some cases of calculous obstruction of the common duct associated with marked jaundice, as well as in certain cases of cholangitis and hepatitis, a cause of mortality is failure to make a preliminary cholecystostomy for the purpose of decompressing the liver. In addition to this preliminary drainage, diathermy, to which I have referred, is a most valuable adjunct. Decompression by simple gall-bladder drainage is likewise applicable to bad risks, such as certain cases of chronic pancreatitis and carcinoma. If improvement follows this procedure and the patient's condition warrants, further

surgery with removal of the pathology may be done. An anastomosis operation may often be successful, although the easiest way out is not by any means always the best, yet it has its indications.

As I have said, the effects of obesity add materially to the surgical risk. As most gall-bladder patients are not emergency cases, some surgeons advise rapid reduction of weight immediately before operation. This is a questionable procedure, inasmuch as it also reduces the patient's power of resistance. If loss of weight is desirable, it should be done slowly by suitable diet and exercise, depending, of course, upon the general health of the patient and the severity of the gall-bladder symptoms. It is in the obese, stocky patient, also, that pulmonary embolism is most likely to occur, although there is no way whatever of foretelling or forestalling this hapless and usually hopeless catastrophe which we all dread and deplore. Coronary thrombosis, on the other hand, is a condition that may have manifested itself before operation. While this complication constitutes an unpleasant surgical risk, spinal anesthesia has brought many of such patients within the operable class; but they require special preoperative and postoperative care to prevent an attack. Sometimes, however, in spite of all precautions, a sudden seizure carries the patient off and surgery bears the blame, unjustly, of course. If, in these cases, the gall-stone disease was of long-standing, the inference is plain.

Hemorrhage, in our experience, rarely occurs except in the presence of severe jaundice, and even then only seldom, owing to the advances made in preoperative and postoperative care by the intravenous administration of calcium chloride and blood transfusion, in addition to x-ray of the spleen before operation to lessen the clotting-time. This is one of the greatest steps forward in gall-stone surgery that has occurred in recent years. An occasional case of carcinoma that has been jaundiced for several weeks will succumb to bleeding after operation, do what you will. This only argues in favor of more prompt interference in jaundiced patients that do not yield to treatment in a week or ten days. Oftentimes the reason for deferring operation is the uncertainty of diagnosis. This, I believe, constitutes one of the strongest indications for opening the abdomen. Primary and consecutive bleeding should not occur if the operation is properly made, and secondary hemorrhage should be rare except in the severely infected cases, and these are not frequent.

Primary and consecutive bleeding are the result of not exposing

and tying the cystic artery or its two branches under the guidance of the eye, the *sine qua non* of a successful operation. Another cause of bleeding is failure to close the gall-bladder bed completely by suture where it has not been possible to do a subserous cholecystectomy, although by careful dissection this can nearly always be done. In closing the gall-bladder bed all small bleeding vessels should be ligatured before the bed suture is introduced. Packing the gall-bladder bed to arrest either primary or secondary bleeding is obsolete, and is only very exceptionally indicated. Here, as elsewhere, knowledge of the anatomical relations of the parts exposed is absolutely essential in order to avoid mistakes. Where bleeding occurs soon after the primary operation, the only rational course, with few if any exceptions, is to open the wound and secure the bleeding point or points. Secondary bleeding, the result of an ulcerated process, is a different proposition. Here, thorough packing carried to the extreme depth of the wound is the correct procedure. Blood transfusion may be necessary, but will not take the place of good surgery, nor is it to be given injudiciously. I have seen serious consequences from blood transfusion, such as a blood-clot, carried along, causing thrombosis, embolism and death.

So-called bile peritonitis, occasionally listed as a cause of death, I believe, in most instances, is not peritonitis at all but intraperitoneal leakage of bile. Whenever I have had the opportunity to operate in such conditions, where a large amount of bile is drained, the smears were negative. Peritonitis with bile in the peritoneal cavity, may result from bacteria having passed through the intestinal walls. Early evacuation of the bile will solve the riddle.

In this connection I would call attention to some recent work of Ravdin, Morrison and Smythe at the Laboratory of Research Surgery of the University of Pennsylvania. They make a distinction between bile peritonitis and bilous ascites transudations or extravasations. In the former the patient presents a picture of a diffuse or diffusing peritonitis, while in the latter there may be a large accumulation of bile-stained fluid which is apparently innocuous. They have confirmed the work of other investigators, that sterile as well as infected bile may cause bile peritonitis. Of course, it is possible that the bile, especially if enough of it is present, causes denudation of the serosal surfaces and thus permits of secondary infection.

In bilious ascitic accumulations, the toxic factor of the bile is either

not present or only a very small amount is present. Ravdin and his coworkers believe that in these cases the fluid is a transudate from the portal system, as a result of portal stasis associated with obstruction of the common duct.

An unique case of bile ascites occurred in my experience some time ago. The patient, a hard-working preacher, was sent to me with the diagnosis of abdominal carcinoma and ascites with jaundice. I concurred in the diagnosis. But when the abdomen was opened there was found a large amount of bile-stained ascitic fluid; a very much enlarged gall-bladder and common duct; with enlargement of the liver, which was normal in consistency but a little darker than normal, due to back pressure of bile; fibrosis of the head of the pancreas; enlargement of the peripancreatic glands, and, on opening the common duct, occlusion of the papilla of Vater. No evidence of stone or malignancy was present. Continuous drainage of the common duct for a number of weeks and dilatation of the papilla of Vater resulted in complete recovery, and the patient has remained well. In passing I may say, in my experience, such cases are rare.

Infection is a cause of mortality in a small percentage of cases, especially where the streptococcus and colon bacillus are the predominant organisms. I am glad to say we do not meet with this as often as formerly, partly due, I think, to the introduction of cholecystography. Cholecystographic study, in fact, is largely responsible for earlier recognition of gall-stone disease by the internist, who usually sees the patient first. I am operating upon more early cases than before Graham's epoch-making discovery, which, no doubt, has lessened the responsibility of the internist and of the surgeon as well. The surgeon, however, still has to make too many decompressions of the liver in jaundiced patients, largely due to delay in advising surgery.

Much has been written upon the relationship between late gall-stone disease and the toxic heart. Granting the views expressed in these discussions to be correct, and I believe they are, the toxic heart then becomes a sequel of delay and fatality caused by such a diseased heart, and should not be shouldered upon the surgeon.

That hepatic insufficiency plays a rôle in the mortality following operation for gall-stone disease is evidenced by the reports of various surgeons on this important subject. We, furthermore, know that hepatic insufficiency is the forerunner of renal insufficiency. This explains why formerly many deaths from hepatic insufficiency were

labeled uremia. The question, naturally, is related to liver function, the study of which is still in its infancy, although progress in the right direction is being made. It goes without saying that a safe and practical test for liver function, such as we have for renal function, would go a great way toward reducing the deaths from hepatic insufficiency, for the results of such tests would decide the question of operation. It is true that the phenoltetrachlorphthalein test claims to meet the requirements of accuracy, simplicity and safety; but its safety is questioned, inasmuch as a deleterious effect on the liver cells has been observed. On the other hand, such an eminent authority as Rowntree finds it a perfectly safe procedure. As I have said, the matter is not as yet definitely settled. Coöperation of the laboratory research workers with the surgeon will finally provide the answer, I feel sure.

On the whole, it may be said that there are still too many patients who come to surgery as a last resort. Improvement in morbidity and mortality of operation for gall-stone disease will go hand in hand with early diagnosis and early surgical treatment where reasonable medical measures have failed.

DISCUSSION

Dr. Hobart A. Hare: No surgeon seems to be bold enough to discuss this paper. I notice there is still a trace in Dr. Deaver of that antagonism a surgeon feels for the internist. I suppose there is not an internist with a large hospital service in Philadelphia that does not have a *bête noir* in his ward, which is the postoperative gall-bladder case, and you see their puckered bellies and other manifestations of adhesions and neuroses until you truly do wonder whether the last state of that woman is not worse than the first. I believe that there is no more serious problem for the internist than that which comes up when he is referring a case of gall-duct or gall-bladder trouble to the surgeon, even if he is as convincing a preacher as my old quizmaster, John B. Deaver, because these patients consider that their internist is their teacher and guide, and they regard the surgeon very largely as the man who is employed, with all his skill, to do the job. Of course, no good surgeon simply is willing to operate on the internist's say so, but the doctor is the patient's next friend, and he says to his doctor: "If I can nerve myself to have this thing done, will I be well?" Now my experience is that a very large per cent cannot be told that they will be well. They may be told that they will be relieved of their attacks of gall-stone colic, or they may be relieved of some other symptom, whatever it may be,

but in many instances the abdominal state of these people is much worse, by and large, than it was before they had operation.

Now one other point—because other Fellows of the College should discuss a paper which is as important as this—Dr. Deaver spoke of dilating the ampulla of Vater. Now with my very limited knowledge, I have always had the conception that some of these cases of cholecystectomy which were followed by marked digestive symptoms were instances in which the ampulla of Vater was incompetent, for one reason or another and, therefore, permitted the bile to dribble constantly from common duct into the intestine. This is not the method of Nature for the delivery of bile into the gut. Those cases do well in which the ampulla of Vater is competent and only relaxes when the pressure in behind is sufficient to overcome it. I have seen one case at least at autopsy (the patient died from another disease), where so much dilatation of the duct occurred, because of competency of the ampulla of Vater, that it acted as a second gall bladder. I do not mean to infer that the ampulla of Vater should not be dilated. I do not mean to say that the cases that I saw have all been operated on at the Lankenau Hospital, but I am going to make my friend, Dr. Deaver, a promise. I am going to make case reports to him of late cases that come into my hospital service that have been operated at the Lankenau Clinic. Now I admit that they belong, as a rule, to what is called the "oi oi" type; that they are neurotic, and if they had amputation would probably always have pain in the stump of the leg. But they are suffering people and have adhesions and you can feel through the belly wall that something is tied down with the puckered scar. Many years ago a distinguished member of this College wrote a paper and published it in *The American Journal of the Medical Sciences*, entitled, "Five Cases of So-and-so: Five Operative Recoveries, Five Deaths." Five operative recoveries and five subsequent deaths! What did the patient seek?

Dr. B. B. Vincent Lyon: I am sure we have all enjoyed Dr. Deaver's excellent paper, but I wonder if he has not presented the subject from a somewhat one-sided point of view?

I have just been working on a review of 1000 cases of gall-bladder disease of various types, not all of them gall-stone cases, but of varying degrees and types of gall-bladder pathology. Since this review is not completed, the figures, are not yet sufficiently accurate for publication. However, I found that, of these 1000 cases, 128 had been previously operated on before I saw them. They were, therefore, presenting themselves with secondary morbidity. The morbidity was of various degrees and types, consistent with cholecystostomy, cholecystectomy, gall-duct and liver damage, etc.: 32 per cent of these 128 cases had had two abdominal operations, 13 per cent had had three to nine abdominal operations, 25 of these 128 cases previously operated were again referred by me for further gall-tract surgery. Of these, there were 3 deaths, or 12 per cent mortality. A very large majority of the remaining 103 cases were restored to health by nonsurgical methods.

There were 68 additional cases in this series referred by me for primary operation. These were chosen with considerable care for both surgical indications and surgical risks. About 85 per cent of them were for cholecystectomy (the surgeons selected were all master surgeons, or at least in Class A group of surgeons): 7 of these 68 patients died, or 10 per cent mortality. Of the 61 of these operative cases which recovered, 22 (36.1 per cent) of them were returned to satisfactory health by the operation alone, 39 (63.9 per cent), however, developed postoperative morbidity that returned them to my observation. Although the morbidity varied greatly, many of them were cases of residual cholangitis and hepatitis which responded satisfactorily to postoperative duodenal drainage. Therefore, of these 1000 patients, 196 operated on have been accounted for as above.

The remaining 804 patients have been treated nonsurgically by various combinations, but the great majority of them have had duodenal drainage at some time or other for a period of three months to three years. The end-results in this group is what I am particularly interested in obtaining. The replies to the follow-up questionnaire at the moment show such incomplete returns as to give no accurate figures now, but the majority of replies have been satisfactory. None of these cases, so far as I know now, has had occasion to appeal to surgery. Probably many of them will have to, probably many of them should now do so. I am sure I have 25 patients in my practice at present whom I have been anxiously trying for one year or more to persuade them to undertake surgery, but they continue to be satisfied with the results. While there is without question an unwise tendency on the part of the internists to delay referring their patients for necessary surgery, perhaps Dr. Deaver is not quite fair in saying that all cases come to him too late or come to the surgeon too late.

A great many of the gall-stone cases today are being seen in young people. We have gradually learned that gall-stone disease is not all in the middle-aged or old; it very often occurs in the child or young adult. In this connection I may cite three instances: Dr. Deaver may remember little Mae S. at the Lankenau, who bore her baby and went promptly into biliary colic with cholesterol stones, probably as early as it could be recognized. Dr. Deaver did a cholecystectomy; but after returning to the ward she redeveloped abdominal colic with jaundice. Dr. Deaver very properly reoperated on the assumption that he had left a stone in the common duct; he could not find it, however, and did a choledochoduodenostomy with temporary improvement. There, however, followed a subsequent postoperative cholangitis with jaundice, chills, fever, sweats, and a second surgeon believed a stone must have been left behind, but upon reëxploring failed to find it and did a choledochostomy. Once more cholangitis developed and she was returned to the Lankenau wards stuporously jaundiced, and treated by the usual old-fashioned methods without recourse to the duodenal tube. She was then transferred to me and common-duct drainage established by means of the duodenal tube, which permitted of cultural study and determination of a hemolytic streptococcic residual cholangitis and hepatitis. We improved her situation by drainage for a year and a half, but again a relapse occurred, so that she was subsequently again

reoperated by a surgeon, who insisted a stone must have been overlooked. In spite of thorough search, he was unable to prove it and did a choledocho-duodenostomy which produced a secondary duodenal obstruction requiring gastroenterostomy under adverse conditions. Although this patient survived, she is now in none too good condition. Although the result by duodenal drainage in this case was not curative, I have successfully handled this serous complication in a number of cases.

Dr. Gibbon may remember the first patient on whom nonsurgical biliary-tract drainage was tried out in 1917. She was little Anna I., who, when fourteen, had an empyema of the gall bladder, and Dr. Gibbon did a cholecystostomy. A few months later he did a cholecystectomy. Recurrent obstructive jaundice required two subsequent choledochostomies, again relapses occurred and a fifth operation was done for release of adhesions. She again relapsed and had four other admissions to the surgical wards with diagnoses which ranged from abdominal adhesions to hysteria. She was then seventeen years of age and had spent about two hundred eighty-five days in the hospital during the preceding three years. She was in profound obstructive jaundice with chills, fever, sweats and leukocytosis, and was a desperately sick girl. By means of duodenal-tube management the obstruction in the common duct was overcome and drainage established. She dejaundiced and her treatment was conducted thereafter by drainage and vaccines over a period of nearly three years. She is now married, has borne three children, and for the last eight years has been as reasonably well as an individual with a moderately damaged liver can be. She has had no relapses with obstructive jaundice since then.

Eight months ago I saw a young woman, aged twenty-five years, whom I referred for surgery last July, having recognized gall stones of the post-pregnancy type. I suggested that she be sent back to me after her cholecystectomy, for appraisal of her liver and bile ducts. It was not considered necessary by the surgeon; he had taken out the gall bladder, he had removed the stones; therefore, the disease was cured. By last December she was back in postoperative obstructive cholangitis. We succeeded in opening the common duct and found that she had a nonhemolytic streptococcic infection which has been cleared by three months' drainage, twice a week, and vaccines.

There are, therefore, two sides to the picture under discussion. I believe that gall-tract diseases start much earlier than we suspect. I think that in some instances we are keeping these cases much longer on a medical régime than we ought to in fairness either to the patient or to the surgeon. However, if the duodenal tube is not used, I believe we are not treating our gall-tract cases as adequately as we can do today, because there is no other way from which so much direct information can be obtained as afforded by duodenal drainage. Duodenal-biliary drainage is of great service in the prevention of more serious gall-tract disease if instituted early and adequately continued. It is of estimable service in the follow-up management of necessary surgery to prevent subsequent postoperative morbidity.

Dr. Deaver (closing): I am perfectly satisfied to leave it to the jury—the College.

THE ETIOLOGY, DIAGNOSIS, TREATMENT AND PROGNOSIS OF AURICULAR FIBRILLATION*

By WILLIAM D. STROUD, M.D.

AND

JOHN A. REISINGER, M.D.

We have chosen auricular fibrillation for presentation, as it is considered by most cardiologists the most common arrhythmia accompanying congestive cardiovascular failure; in fact, Sir Thomas Lewis finds it present in 62 to 70 per cent of all such cases admitted to general hospitals.[1]

We stress etiology, as in our opinion the biggest advances during the past fifteen to twenty years in the treatment and prognosis of cardiovascular diseases has been due to the realization that the underlying etiological factor in cardiovascular conditions probably determines the prognosis as much as any pathological structural changes.

We have made a table as to the etiology in the original 134 cases of auricular fibrillation studied by one of us for the past seven years,[2, 3] and another table of a series of 56 cases analyzed by Dr. Reisinger during the past year.

A clinical diagnosis of practically all the cardiac arrhythmias should be possible; but if the type of arrhythmia in any one case seems uncertain in the mind of a physician, he should certainly have such a diagnosis confirmed by electrocardiography. This fact should be evident to all, as the prognosis and treatment in cardiac arrhythmias, depending upon their type, vary within such a wide range. The usual clinical procedure is to determine the heart-rate, and if there is a definite arrhythmia with a ventricular rate above 110, one is quite safe in the majority of cases in making a diagnosis of auricular fibrillation. This may be confirmed, if the patient's condition warrants, by a mild exercise test during which the rhythm will become more regular in cases of multiple extrasystoles and

* Read March 6, 1929.

more irregular in cases of auricular fibrillation, with an increase in cardiac rate.[1, 4] We wish to stress the importance, in our opinion, of diagnosing arrhythmias by listening at the apex of the heart instead of depending upon the pulse alone. This is especially important in auricular fibrillation, as it is only through this procedure that one may estimate the pulse deficit—in other words, the difference between the apical heart-rate and the pulse-rate—which is such an important factor in estimating the efficacy of treatment.

Etiology.	No.	M.	F.	Average age.	Average age infection.	Average age onset.	Quinidine.	Unsuccessful.	Successful.
Thyroid . . .	2	0	2	52	49	51	1	. .	1
Syphilitic . . .	9	8	1	53	. .	52	3	2	1
Rheumatic (no history) . . .	27	17	10	37	. .	34	11	2	9
Rheumatic (history) . . .	42	26	16	36	16	34	19	7	12
Arteriosclerotic .	54	43	11	59	. .	56	8	4	4
Totals . .	134	94	40	. .	. .	. .	42	15	27
Thyroid . . .	2	1	1	39	. .	37			
Syphilitic . . .	5	5	0	50	. .	49			
Rheumatic (no history) . . .	11	4	7	36	. .	31	3	1	2
Rheumatic (history) . . .	20	10	10	44	18	40	3	0	3
Arteriosclerotic .	18	11	7	60	. .	58			
Totals . .	56	31	25	. .	. .	. .	6	1	5

Although it is impossible to go into a discussion of electrocardiography, yet the following slide gives you some idea of just what an electrocardiogram is, and from the diagram it is possible to rapidly review the physiological factors in normal sinus rhythm and in auricular fibrillation.

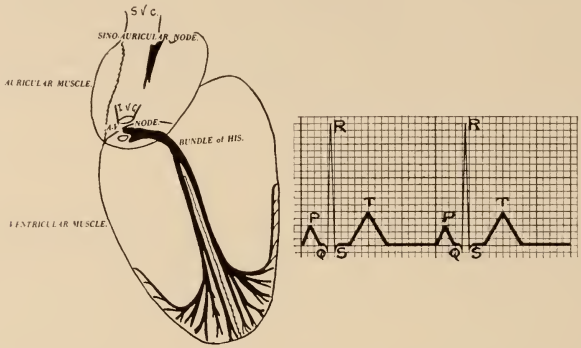
Next is a slide of a relatively normal electrocardiogram. There is a marked sinus arrhythmia in this patient; but, as you know, this arrhythmia is unimportant from the standpoint of treatment.

Important Points in Digitalis Therapy

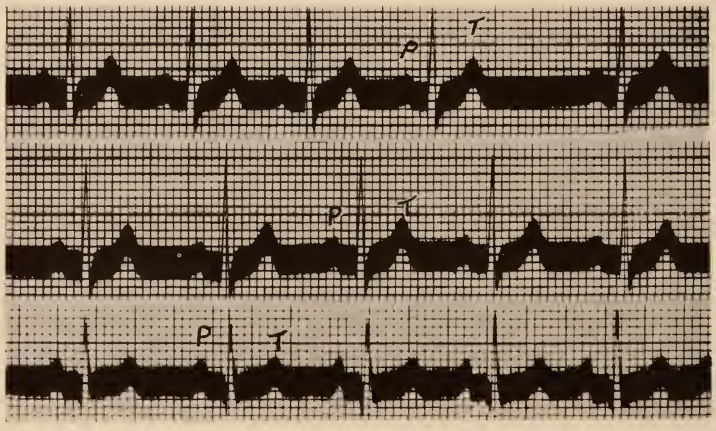
1. Small doses of digitalis in auricular fibrillation, unless given over many weeks, are of little value.

2. Gradually increasing benefit is derived as the point of therapeutic concentration is reached.

3. This point should be determined by counting the apical-rate (ventricular-rate), and not, the pulse-rate alone, or upon the appearance of nausea or vomiting.



Slide 2.—Cardiac impulse arises in the sino-auricular node, travels through the auricle to the auriculoventricular node (the *P-R* interval in the electrocardiogram, normal less than 0.20 second) through the Purkinje system to the ventricular muscle (the *Q-R-S* complexes, normal less than 0.10 second). After Roth, Cardiac Arrhythmias, P. B. Hoeber, Inc., 1928.



Slide 3.—Three leads of a relatively normal electrocardiogram except for marked sinus arrhythmia as indicated by the variability of the *T-P* interval.

4. This point is reached in the average patient after giving 2 minims (or 5 gtts.) of a potent tincture, or $\frac{1}{5}$ gr. of a powdered leaf, per pound of the patient's weight excluding weight of edema. Patient 120 pounds, 240 minims = 600 gtts. = 24 grs.; patient 150 pounds, 300 minims = 750 gtts. =

30 gr. (Above estimates must be modified as average patient eliminates about 20 minims = 50 gtts. = 2 grs. per day.)

5. To continue maximum benefit the patient must be kept on daily-maintenance dose. This averages between 20 and 30 minims = 50 and 75 gtts. = 2 and 3 grs.

In all cases of auricular fibrillation with evidence of circulatory insufficiency, it is admitted by all cardiologists, digitalis is the drug of choice. It apparently was upon the results of the treatment of this arrhythmia with digitalis that this drug established its great reputation in the handling of cardiovascular cases since the time of Withering.[5] The use of digitalis in the treatment of circulatory failure has materially changed during the past fifteen to twenty years. The following slide illustrates the approximate routine upon which we place our patients with auricular fibrillation on the service of Dr. George W. Norris at the Pennsylvania Hospital. This illustrates a hypothetical case, but can easily be applied with modifications to individual cases. Digitalis is used in larger doses in other parts of the country and also in smaller doses, but we believe this represents the best routine as determined by various investigators of the action of digitalis.[6, 7, 8, 9]

Our Average Procedure with Digitalis in Auricular Fibrillation
(Weight 150 pounds, estimated free of edema)

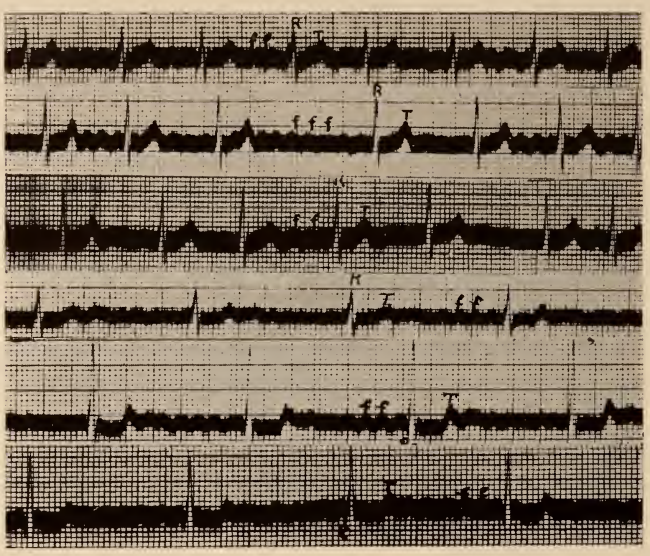
		F. R.	H. R.	P. R.
24 hrs.	60 minims, 6 grains	450–500	180–200	60–110
	30 minims fourth hour (while awake) 4 doses			
	Total 180 minims, 18 grains	470–510	140–160	62–112
48 hrs.	30 minims fourth hour (4 doses).			
	Total 300 minims, 30 grains	480–510	100–120	68–112
72 hrs.	20 minims fourth hour (4 doses).			
	Total 380 minims, 38 grains	490–520	80–100	70–100
96 hrs.	10 minims t.i.d. (3 doses).			
	Total 410 minims, 41 grains	500–520	70–80	70–80

(Daily maintenance dose of digitalis, 20 to 30 minims, 2 to 3 grains). (Decision as to quinidine sulphate.)

Next is a slide of a rheumatic auricular fibrillator, well controlled with digitalis and in whom we were unsuccessful in restoring sinus rhythm. This illustrates how difficult it is in fibrillators with slow rhythm to make a diagnosis clinically.

We again wish to stress the importance of the diagnosis of this

arrhythmia by counting the heart-rate at the base, and if doubtful by the use of the electrocardiogram.



SLIDE 5.—The upper three leads are of a typical auricular fibrillation. The lower three leads are from the same patient with further digitalization with the production of a complete heart-block. The equal spacings of the ventricular complexes which correspond to the first heart sounds at the apex, show how difficult it is clinically to diagnose auricular fibrillation after complete digitalization.

Having restored the individual patient's circulation with rest, diet and digitalis therapy to the maximum efficiency possible in that individual patient, the next step is to determine whether one wishes to keep that patient upon a daily maintenance dose of digitalis for the rest of his life or to attempt to restore the sinus rhythm with quinidine sulphate. It must be remembered that quinidine sulphate is a myocardial poison and that dangers attend its use. The following slide illustrates certain conditions in which we believe quinidine sulphate may be indicated.

POSSIBLE VALUE OF QUINIDINE SULPHATE THERAPY

1. Multiple premature contractions.
2. Paroxysmal or constant auricular flutter, if digitalization is not successful, and to hasten a return of sinus rhythm after conversion to fibrillation with digitalis.

3. Rheumatic cardiovascular disease, with premature contractions; possibly potential cases of auricular fibrillation.
4. Degenerative cardiovascular disease with premature contractions; possibly potential cases of auricular fibrillation.
5. Cases of auricular fibrillation of various etiology (*a*) of recent development; (*b*) which respond rapidly to digitalis therapy and rest; (*c*) little if any evidence of congestive circulatory failure; (*d*) fluroscopic evidence of vigorously pulsating ventricles.[10]

We believe if quinidine sulphate is used in auricular fibrillation that the patient should be at absolute rest in bed and a galvanometer available in order positively to determine the point at which sinus rhythm is restored. The following are possible occurrences which make quinidine sulphate therapy hazardous:

Possible Causes of Fatal Results with Quinidine Sulphate Therapy

1. Vascular occlusion by embolus or thrombosis.
2. Ventricular fibrillation.
3. Respiratory paralysis.

In our series of 190 cases of auricular fibrillation there have been 4 cases of hemiplegia, none of which have ever had quinidine sulphate therapy.

Our Average Procedure with Quinidine Sulphate

Patient confined to bed with galvanometer available (continue daily-maintenance dose of digitalis)

Quinidine sulphate, 3 grs., given the preceding day as a trial dose.

		A.M.	P.M.	A.M.	
24 hrs.	Quinidine sulphate, 3 grs.	at 6 and 10	2, 6 and 10	2	18 grs.
48 hrs.	Quinidine sulphate, 3 grs.	at 6 and 10	2, 6 and 10	2	36 grs.
72 hrs.	Quinidine sulphate, 6 grs.	at 6 and 10	2, 6 and 10	2	72 grs.
96 hrs.	Quinidine sulphate, 6 grs.	at 6 and 10	2, 6 and 10	2	108 grs.
120 hrs.	Quinidine sulphate, 9 grs.	at 6 and 10	2, 6 and 10	2	162 grs.
144 hrs.	Quinidine sulphate, 9 grs.	at 6 and 10	2, 6 and 10	2	216 grs.

If unsuccessful after seven to ten-day interval, repeat the above procedure.

Then follow 3 slides of electrocardiograms in various cases of auricular fibrillation.

We have attempted to follow these cases as carefully as possible, in order to determine how long after they have begun fibrillating they are able to work or are in satisfactory condition under greatly modified daily routine, or in an unsatisfactory condition in spite of treatment or have died. The following slides give, so far as we have been able to collect this information, some idea of these find-

ings in those cases in which we have attempted to use quinidine both successfully and unsuccessfully:

SUCCESSFUL WITH QUINIDINE

Etiology.	Fibrillation before quinidine.	N. S. R. after quinidine.	Fibrillation after quinidine.	Total fibrillation.	Present status.
Rheumatic (history)	2 wks.	1 yr.	1 yr.	2 yrs.	Died.
Rheumatic (history)	6 mos.	4 yrs.	.....	.....	Lost.
Rheumatic (history)	6 mos	18 mos.	.....	.....	Lost.
Rheumatic (history)	3 mos.	1 yr.	18 mos.	.....	Lost.
Rheumatic (history)	3 mos.	12 mos.	4 yrs.	6 yrs.	Not satisfactory; not working.
Rheumatic (history)	2½ yrs.	12 mos.	4 yrs.	7½ yrs.	In Naval hospital.
Rheumatic (history)	1 yr.	1 yr.	1 yr.	3 yrs.	Not working.
Rheumatic (history)	2 yrs.	5 yrs.	2 yrs.	9 yrs.	Satisfactory.
Rheumatic (history)	3 mos.	3 yrs.	.....	3¼ yrs.	Working.
Rheumatic (history)	1 wk.	2 yrs.	.....	2 yrs.	Working.
Rheumatic (history)	3 mos.	7 mos.	2 yrs.	3 yrs.	Not satisfactory.
Arteriosclerotic . .	1 yr.	4 yrs.	.....	5 yrs.	Died.
Arteriosclerotic . .	1 yr.	6 yrs.	.....	.....	Lost.
Arteriosclerotic . .	2 yrs.	2 yrs.	1 yr.	5 yrs.	Light work 2/7/29.
Arteriosclerotic . .	6 mos.	3 yrs.	6 mos.	4 yrs.	Working.
Arteriosclerotic . .	7 yrs.	3 mos.	3 yrs.	10 yrs.	Not satisfactory.
Thyroid	7 mos.	15 mos.	.....	2 yrs.	Working.
Syphilitic . . .	3 wks.	1 mo.	.....	.....	Lost.
Rheumatic (no history)	2 mos.	3 mos.	.....	.....	Died.
Rheumatic (no history)	4 yrs.	6 yrs.	1 yr.	11 yrs.	Working part time.
Rheumatic (no history)	5 mos.	1 mo.	.....	.....	Lost.
Rheumatic (no history)	5 mos.	2 mos.	.....	.....	Lost.
Rheumatic (no history)	2 wks.	3 mos.	.....	.....	Lost.
Rheumatic (no history)	3 yrs.	4 yrs.	.....	.....	Working January, 1928.
Rheumatic (no history)	6 yrs.	2 yrs.	.....	.....	Working, 1927.
Rheumatic (no history)	1 mo.	5 yrs.	.....	5 yrs.	Light housework.
Rheumatic (no history)	3 mos.	7 mos.	.....	10 mos.	Satisfactory;housework.
Rheumatic (no history)	1 mo.	6 mos.	.....	7 mos.	Satisfactory; light housework.
Rheumatic (history)	1 yr.	2 yrs.	.....	3 yrs.	Died.
Rheumatic (history)	3 mos.	10 mos.	.....	1 yr.	Died.
Rheumatic (history)	1 mo.	1 yr.	1 mo.	14 mos.	Died.
Rheumatic (history)	2½ yrs.	4 yrs.	2 mos.	7 yrs.	Died.

UNSUCCESSFUL WITH QUINIDINE

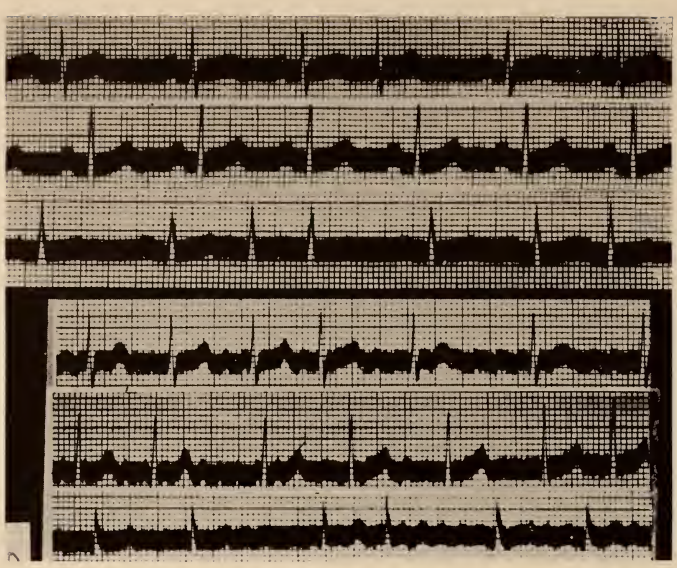
Etiology.	Fibrillation before quinidine.	Fibrillation after quinidine.	Total fibrillation.	Present status.
Syphilitic	3 yrs.	1 yr.	4 yrs.	Died.
Syphilitic	4 wks.	4 yrs.	4 yrs.	Working.
Rheumatic (no history)	3 yrs.	.....	3 yrs.	Lost.
Rheumatic (no history)	.....	.....	8 mos.	Working.
Rheumatic (history)	4 days	3 wks.	4 wks.	Died.
Rheumatic (history)	7 mos.	3½ yrs.	4 yrs.	Died.
Rheumatic (history)	2 yrs.	1 yr.	3 yrs.	Died.
Rheumatic (history)	1 yr.	6 yrs.	7 yrs.	Died.
Rheumatic (history)	4 mos.	.....	.....	Lost.
Rheumatic (history)	10 days	5 yrs.	5 yrs.	Working.
Rheumatic (history)	3 yrs.	.....	5 yrs.	Working 1927.
Rheumatic (history)	7 yrs.	1 yr.	8 yrs.	Hemiplegia; satisfactory
Arteriosclerotic	16 mos.	3½ yrs.	5 yrs.	Died.
Arteriosclerotic	4 mos.	.....	4 mos.	Died. after 21 grs. quinidine.
Arteriosclerotic	14 mos.	3 yrs.	4 yrs.	Died.
Arteriosclerotic	10 yrs.	.....	.....	Lost.

Total number of cases	48
Number successful	32
Per cent successful	66
Number unsuccessful	16
Per cent unsuccessful	33

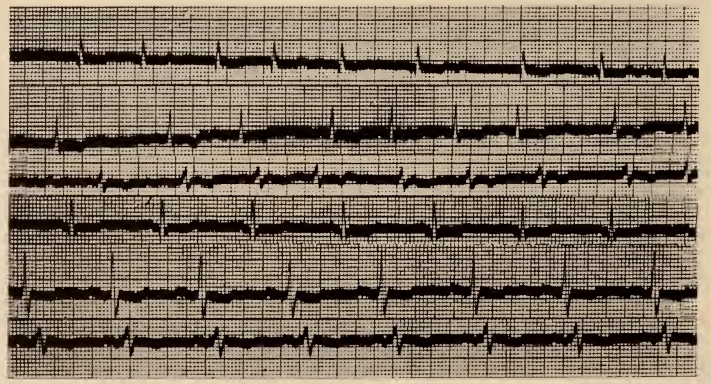
	Successful.	Unsuccessful.
Cases	32	16
Per cent dead	21.8	50
Per cent working	31	25
Per cent lost	28	25
Per cent satisfactory, not working	6	

SATISFACTORY FOLLOW-UP ON 140 OF 189 CASES OF AURICULAR FIBRILLATION

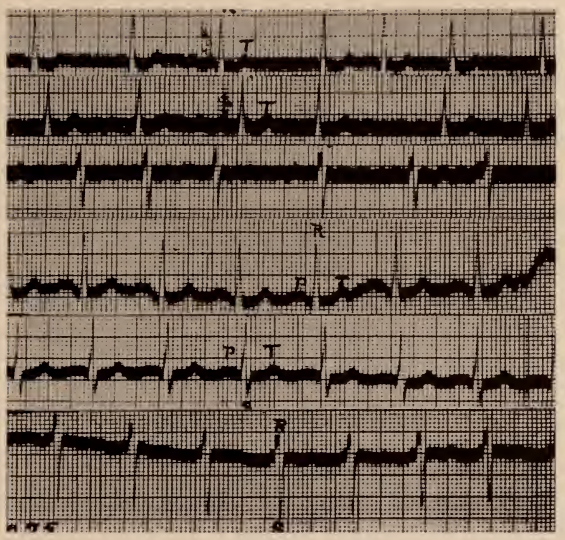
Etiology.	Number.	Number working.	Number satisfactory.	Number unsatisfactory.	Number dead.
Thyroid	4	1	2	..	1
Syphilitic	10	1	..	1	8
Rheumatic (no history)	25	8	2	3	12
Rheumatic (history)	51	9	12	9	21
Arteriosclerotic	50	10	15	5	20
Total	140	29	31	18	62



SLIDE 8.—Successful quinidine sulphate therapy in a case of arteriosclerotic auricular fibrillation with restoration to normal sinus rhythm, except for occasional auricular extrasystoles (premature contractions), the lower three leads while fibrillating and the upper three leads following quinidine.



SLIDE 9.—Restoration to normal sinus rhythm in the case of a physician, aged fifty-five years, with arteriosclerotic cardiovascular disease and signs of congestive circulatory failure. This patient has maintained the sinus rhythm for three years. The upper three leads are of fibrillation and the lower three leads after quinidine sulphate therapy.



SLIDE 11.—A case of rheumatic cardiovascular disease with mitral stenosis and auricular fibrillation restored to sinus rhythm by quinidine sulphate. The latter rhythm has been maintained for four years and no symptoms of congestive circulatory failure have developed. The upper three leads are of fibrillation and the lower three, after restoration to normal sinus rhythm. In both, there is evidence of a left axis deviation (ventricular preponderance).

In order to ascertain the opinions of representative men who have been using digitalis and quinidine sulphate in the treatment of auricular fibrillation for some years, I wrote to Dr. Samuel Levine, in Boston, Dr. Walter Hamburger, in Chicago, and Dr. John Wyckoff, in New York. We are practically in accord with their conclusions and those of Parkinson and Campbell,[11] of England:

1. That quinidine is of definite value in cases of paroxysmal auricular fibrillation and in some cases of multiple ectopic beats.

2. That in well-selected cases of chronic auricular fibrillation, if successful in restoring sinus rhythm, the circulation seems to be more efficient than with digitalis controlling the ventricular rate.

3. That, although there does seem to be a definite danger in using quinidine sulphate, if the patient is kept under careful observation this danger is probably less than was first anticipated.

4. That if the patients are carefully chosen and quinidine sulphate properly administered, the percentage of successful returns to sinus rhythm is considerably higher than 50 per cent.

To summarize our presentation, we have stressed the importance of etiology in the diagnosis, prognosis and treatment of cardio-

vascular cases; we have outlined the treatment of the average cases of auricular fibrillation by the use of digitalis and quinidine sulphate, presenting the points to be gained and the dangers guarded against in the use of the latter drug. We feel that quinidine sulphate has a place in the treatment of chronic auricular fibrillation, but that the cases must be carefully selected and that the treatment must be carried out with the patient under constant observation, and if properly carried through, will give satisfactory results in such carefully selected cases in a higher percentage than has been heretofore reported.

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DISCUSSION

Dr. Hobart A. Hare: Sir Thomas Lewis attributed more value to quinidine to study the physiology of the heart than as a therapeutic agent. It is true that only 50 per cent are benefited. Quinidine is a definite cardiac depressant; myocardial degeneration, if present, makes the patient entirely unfit for free administration of this drug, except when it can be controlled by the electrocardiograph, as Dr. Stroud has done. The doses shown on the chart are very much larger than generally employed.

Dr. Stroud: Nine grains of quinidine sulphate six times in the twenty-four hours is as high as we usually go.

Dr. Hare: That is usually considered sufficient.

Dr. Stroud (closing): We agree with Dr. Hare that these cases should be very carefully selected, and that the patients should be in bed during the treatment and that a galvanometer should be available. Of course, we believe that quinidine sulphate will never replace digitalis in the treatment of auricular fibrillation.

A CONSIDERATION OF THE POSSIBILITY OF THE PREVENTION OF ARTERIOSCLEROTIC HEART DISEASE*

By JOHN WYCKOFF, M.D.
NEW YORK.

Karsner, quoting Thorel, defines arteriosclerosis "in the broader sense as including all those pathological alterations of arteries which lead to the thickening of the wall, particularly the intima, and which in their development exhibit degenerative processes, such as fatty and mucoid degeneration with their sequence." Included in Thorel's conception "are calcification, also in the media, and, in addition, hyperplastic alteration of the connective tissue and elastic elements of the intima and, perhaps also, inflammatory proliferative growth of the connective tissues of the intima." MacCallum[1] states that Marchand sums up arteriosclerosis almost identically.

In this definition Karsner does not intend to include Mönckeberg's arteriosclerosis, which he describes as beginning with the fatty degeneration of the middle layers of musculature and elastica of the media, sometimes associated with necrosis, and in which there develops later a calcification in the same situations, giving rise to the corduroy or pipestem arteries. He, also, excludes endarteritis obliterans and syphilis of the bloodvessels.

Chronic interstitial myocarditis, commonly called chronic fibrous myocarditis, is frequently associated with both arteriosclerosis as broadly defined by Thorel and with the senile arteriosclerosis of Mönckeberg. However, it is also found as an end-result of acute inflammatory changes and is associated with syphilis of the bloodvessels. Chronic interstitial myocarditis is observed as a diffuse fibrosis or in a localized form. Alone, myocarditis may in certain stages give the same macroscopical and microscopical picture whether associated with syphilis, arteriosclerosis or as the possible end-result of previous inflammation. Krumbhaar,[2] in discussing interstitial myocarditis and myocardial fibrosis, states there are

* Read April 3, 1929.

included several different forms of fibrosis which are more in the nature of degenerative and reparative changes than of true inflammation, and, further, states that, though cases of myocardial fibrosis may be accounted for, as Aschoff claims, as the end-result of inflammation, it must be recognized that any condition which prevents the supply of sufficient nourishment for the cardiac muscle may bring about degeneration of muscle fibers, with the gradual replacement by fibrous tissues. Besides chronic interstitial myocarditis, there is frequently an associated enlargement of the heart resulting from increased resistance to the peripheral circulation or to valvular defects. Associated with arteriosclerosis of the coronary vessels, we may have, in addition to minute areas of fibrosis, infarction of cardiac muscle and spontaneous rupture occurring at the site of such infarction or healing with or without aneurysm. Chronic enodcarditis may also be the result of different causes. Krumbhaar[2] states it may occur (*a*) secondary to either simple or mycotic endocarditis, (*b*) as a primary degeneration similar to arteriosclerosis, (*c*) in case of syphilis as a true chronic inflammation and (*d*) as the result of a combination of two or more of these causes. The changes of chronic valvulitis due to syphilis are usually characteristic, but at times the differences between the chronic valvular disease due to the end-result of an infection and that associated with arteriosclerosis are confusing. However, as the life history of individuals having these various degenerative forms of structural changes in their hearts differs when they are associated with syphilis and with degenerative arterial changes, the term "arteriosclerotic heart disease" is used to denote those pathological changes occurring in the heart structures associated with arteriosclerosis of the blood-vessels.

To summarize, chronic degenerative changes in the heart characterized by fibrosis of the myocardium by changes of the valves, with or without hypertrophy, may be the end-result of certain acute inflammatory changes, may be associated with vascular syphilis or may be associated with arteriosclerosis. The life history of these three groups and, therefore, their clinical pictures differ. For this reason, arteriosclerotic heart disease is used to denote the cases in this group which are associated with definite arteriosclerosis, including both the broad classification of Thorel and that of Mönckeberg as defined above, and, also, such patients showing definite coronary sclerosis and the usual phenomena accompanying such change.

In discussing the causes of arteriosclerotic heart disease, one discusses the causes of arteriosclerosis; the general impression which one gains after a rather thorough reading of the subject is that, after years of work and labor, little is actually known of the cause. This is probably, in part, due to the fact that arteriosclerotic heart disease is not a single disease and must be further subdivided into smaller groupings, whether these be based upon a clinical concept, as so vigorously demanded by Allbutt,[3] or upon finer pathological distinctions, as have been attempted by many pathologists. The portion of any article treating of arteriosclerosis which deals with cause usually begins with the statement that the causes are obscure. In discussing this point, MacCallum[1] makes the following illuminating observation:

"Arteriosclerosis is one of those diseases difficult to explain, because it develops so slowly, through long years of life, during which a great many possible causes have had an opportunity to affect the tissues. Our brilliant discoveries as to the etiology of disease come most readily when the transition from health to a pathological state is sudden and easily recognized by symptoms. Hence every conceivable idea has been expressed and tenaciously maintained with regard to this condition, and many of them are so vague and ill-supported that it is wearisome to discuss them. None, however, is clearly demonstrated to have a definite bearing on the etiology of arteriosclerosis, and we are quite as ignorant of its underlying cause as were our forefathers in the days of Morgagni."

In addition to the factors of age and heredity, the following theories have been advanced for the causation of arteriosclerosis: (1) the mechanical theory, which lays it to hypertension, whether general or local; (2) the infectious theory, that it is the result of infection; (3) the toxic theory, and (4) the metabolic theory. The literature on the subject is tremendous and far from being conclusive. I will briefly summarize some of the more important findings.

I. Let us consider, first, the question of age. The term "arteriosclerotic" is so often used to symbolize senescence that age alone is considered to be a frequent cause of arteriosclerosis. However, the moment one begins to study this subject closely, inconsistencies at once arise to make us question whether age *per se* is actually a factor in the production of arteriosclerosis, and, if so, whether it is a notable one. In discussing this subject we must clearly differentiate between the differences which go on in any living organism due to age itself, and those changes which occur as the result of

influences coming from without the cell, such as faulty metabolism, infection, trauma, etc.

In a study of the etiological types of heart disease, we have shown that arteriosclerotic heart disease increases steadily with each decade. Therefore, it is possible that because of the greater age of these patients there has been more opportunity for external factors to play a part in the production of arteriosclerosis.

In this connection, MacCallum[1] states that "mere old age can hardly be regarded as a separate factor in producing this condition, since it is necessarily complicated by many other possibilities."

Allbutt,[3] in discussing the relationship of age to arteriosclerosis, says: "Marvelous as, in the human frame, are the symmetry of parts and the harmony of function, it cannot be supposed that the stealthy hours carry away no quality of tissue, no quantity of energy," but then goes on to cite many cases of patients over seventy years of age showing little or no evidence of arteriosclerosis.

MacCallum,[1] further, states that, in an analysis of many cases of autopsies by decades, arteriosclerosis does not steadily increase with age; on the other hand, Romberg considers old age to be an essential factor.

II. Heredity. Osler,[4] in his text-book, speaks of the quality of arteries with which one is born. Stengel[5] has defended the theory that there is such a thing as a family predisposition to hypertensive arteriosclerosis. Allbutt[3] states that there should be a differentiation in such studies between the arteriosclerosis due to high blood-pressure and those due to premature arterial decay. Allbutt[3] states, in respect to arteriosclerosis, that there are two modes of hereditary transmission, direct and indirect. He further explains that, by the direct, he means that type which he calls the decrescent or primary, which consists apparently in an original fraility or toxic susceptibility of the arterial structure and which frailty or susceptibility, he believes, may run in families; the indirect or hyperpietic, a secondary event which, he believes, depends not upon an original arterial frailty, but upon a proclivity to some ill-understood poison or perversion making for high blood-pressure.

III. High Blood-pressure. In discussing high blood-pressure as a cause of arteriosclerosis, when we are particularly interested in the prevention of arteriosclerosis, we must not lose track of the fact that we are interested in high blood-pressure only in an intermediary sense, that is, granted that high blood-pressure is a factor

in the production of arteriosclerosis, we are then interested in the causes of such high blood-pressure, as it is only by attacking such primary causes that we may expect to eliminate arteriosclerosis secondary to hypertension, if such occurs.

Under this heading we, therefore, have two questions demanding considerations: (1) Is hypertension a factor in the production of arteriosclerosis, and (2) if so, what are the causes of such hypertension?

In regard to the first, there is certain evidence that hypertension is a factor in the production of arteriosclerosis. This is true whether one wishes to go as far as Allbutt,[3] and consider the type of arteriosclerosis occurring with or following hypertension as being a different disease entity, or whether one believes, with Eli Moskowitz,[6] that the sole cause of arteriosclerosis is hypertension.

The work of Ljungdahl,[7] and also of Moskowitz[6] showing that arteriosclerosis of the pulmonary arteries occurs only when there is increased pulmonary pressure, as associated with mitral stenosis, congenital malformations, extreme pulmonary emphysema and chronic pulmonary infection, is evidence of this. Klotz's[8] work in the production of arteriosclerosis in the carotid and thoracic vessels of rabbits, by raising the pressure in these vessels by inverting the rabbits several hours a day, also points toward this conclusion. On the other hand, we have all seen long-standing cases of high blood-pressure resulting in little or no arteriosclerosis.

We now come to the second question, the causes of hypertension. Meakins,[9] in his review of arterial hypertension and hypotension and their clinical significance, says: "It will be obvious that our knowledge of the underlying cause and of the processes whereby these changes in arterial function are brought about is quite meager," and, further, he states: "Critical contributions undertaken to explain pathological changes are relatively so few that the proper perspective has not been maintained."

In regard to the climacteric as a cause of hypertension, after reviewing the literature, he states: "The comparatively frequent development of symptoms indicative of changes in blood-pressure during the decade has led some to suppose that there is a connection between such changes and the climacteric. The concrete evidence does not, however, support this supposition. The cases reported where a direct relation would seem to exist are so few, and the enormous number of cases where such an association is absent,

would lead to the conclusion that any apparent connection is coincidental."

Work. The effect of physical work on blood-pressure has been studied. It may be said that there is a short primary increase, followed by a less-sudden fall. Studies of the effect on blood-pressure after work has ceased are at variance. Meakins[9] says: "It would seem to be proven that immediately on the cessation of the work there is a preliminary rise in the systolic pressure and then a fall, which may continue to below the normal resting pressure and then gradually return to the base line. The extent of these variations would seem to depend on the degree of exercise undertaken."

The effect of mental work on blood-pressure is similar. Landis and Gullette[10] state that only the emotions of sex excitement, surprise and fear were productive of change in systolic blood-pressure, and these changes were only temporary in character.

Blood-pressure may be altered voluntarily by increased work, physical or mental. This is caused by increase in cardiac output or by modifying the character of the peripheral circulation. Within certain limits, it may be stated that the more active the metabolism the greater the cardiac output and the higher will be the blood-pressure, and the diastolic arterial pressure is in proportion to the degree of peripheral vascular resistance. In considering various pathological states as associated with high blood-pressure as a possible cause the above two factors must be kept in mind.

Ductless Glands. The rôle which the ductless glands play in the production of blood-pressure is certainly little known. There are many differences of opinion and little real knowledge. Meakins[9] states: "The supposition that a deficiency of some, or perhaps all, of the ductless glands is conducive to a lowering of blood-pressure has been arbitrarily adopted by many clinicians." Plummer[11] has shown that systolic blood-pressure is increased in hyperthyroidism. Troell[12] has found this increase in blood-pressure parallel to the increase in the basal metabolic rate.

Obesity. Dunham,[13] and also Hunter and Rogers,[14] have shown that patients who are overweight tend to have high blood-pressure, and those underweight lower blood-pressure, and because of this fact it is sometimes thought that obesity is a cause of hypertension. Aubertin[15] thinks, rather, that obesity and hypertension both arise from a common cause. O'Hare[16] notes that hyperglycemia, obesity and hypertension frequently occur together. Herrick[17] confirms these

findings, reporting a series of cases with hypertension, hyperglycemia, obesity and arteriosclerosis, which he holds constitute a definite clinical group and claims it is rare to find hyperglycemia in a thin person with hypertension.

IV. Mental. To return to the direct causes of arteriosclerosis, the part played by mental activity, excitement and various nervous disturbances in the production of arteriosclerosis has been stressed by various authors, notably Huchard.[18] MacCallum[1] thinks they may have an indirect bearing through disturbances of metabolism, or they may be the expression of some intoxication which lies at the root of the arteriosclerosis, rather than a direct cause. He also suggests that the association of such diseases as gout, diabetes, chronic nephritis and obesity with arteriosclerosis may be due to their both arising from a common cause, rather than that one follows the other.

V. Infection. MacCallum[1] gives as, perhaps, the three most important factors in arteriosclerosis, infections, intoxications and unbalanced diets. Huchard[18] particularly stressed the importance of infections in the production of arteriosclerosis, but he did this in a rather general way. Thayer,[19] in studying autopsies of patients dying from typhoid fever, showed fatty changes particularly in the aorta and fresh sclerotic placques in the aorta and coronary arteries. He, furthermore, studied cases of typhoid fever that had recovered and had been followed up months or years after recovery, and found they showed signs of thickening of the peripheral arteries in a higher percentage than in a group of controls.

Frothingham,[20] and also Wiesel,[21] report they have found bloodvessel changes in children dying from diphtheria. Inflammatory changes in bloodvessels have been reported after pneumococcus, staphylococcus and streptococcus infections by various authors. Particularly interesting is the recent work of Pappenheimer and von Glahn,[22] showing the change in the bloodvessel in rheumatic fever.

While all these facts are undoubtedly true, there have been very few careful follow-up studies made to determine whether the percentage of arteriosclerosis developing after these infections is greater than in a control series of patients who have not had these infections. The study of Ophüls,[23] on the relation of arteriosclerosis to infectious disease, in which he studied 500 cases, is an example of how such studies should be made. While it is true that acute infections cause

acute inflammatory change in the bloodvessels, and while it is probable that, reasoning by analogy, we may feel that the infections play a great rôle in the production of arteriosclerosis, there is as yet little evidence to this effect. It is interesting to note, in this connection, that Ophüls[23] feels it is confusing to consider that the associated renal lesion and arteriosclerosis are dependent upon each other; he feels, rather, that they are dependent upon a common cause.

The experimental evidence which has been made to produce arteriosclerotic lesions by experimental inoculations seems to show definitely that arteriosclerosis may be produced by the injection of either dead or living bacteria or their toxins.

In summing up the literature on the relation of infection to arteriosclerosis, MacCallum[1] states: "Nevertheless, in spite of all these experiments and these statistical studies of the coëxistence or later occurrence of arteriosclerotic lesions in persons affected with infectious diseases, there is brought no satisfactory proof of the thesis that infection is the direct cause of arteriosclerosis. It seems the most plausible idea so far mentioned, but it will require far more study before we see the relation clearly."

VI. Toxins. The relation of certain toxins other than the toxins of infection as a causation of arteriosclerosis have long been considered. We may mention particularly alcohol, tobacco, lead and toxins from the gastrointestinal tract. There is very little direct evidence that either alcohol or tobacco are factors in the production of arteriosclerosis. It seems strange that now, when the serious significance of arteriosclerosis has been known for so many years, carefully collected data has not been subjected to equally careful statistical study and these moot questions permanently answered. That lead poisoning does produce arteriosclerosis seems to be better proven, but the question of the possible relation of so-called autointoxication to arteriosclerosis seems never to have been attacked in such a way as definitely to determine its existence.

VII. Metabolism. Investigations have been carried on along many lines to determine the relationship between disorders of metabolism and arteriosclerosis. This has been done in various ways, one of which has been by the feeding of diets rich in protein, fat or carbohydrate to experimental animals.

Nuzum, Osborne and Sansum[24] fed rabbits on high-protein diets for twenty-one months. Such feedings were followed by increased blood-pressure, which was maintained. Control groups at the same

time maintained a normal blood-pressure. Nuzum[25] and his coworkers showed those rabbits who had been on a high-liver diet and oat-protein diet developed definite arteriosclerosis of the aorta and coronary vessels, but those on the soy-bean diet showed almost no such sclerosis. Newburgh and his coworkers[26] have produced chronic nephritis by feeding the amino-acids and diets high in fat.

Tolstoi,[27] studying the chemical constituents of the blood of Arctic explorers, fed on an exclusive meat diet, found little or no change except a slight increase in uric acid and temporary lypemia. The health of the patients was excellent and no evidence of renal impairment was found.

Heinbecker[28] showed that Eskimos—living on a diet of protein, 280 grams; fat, 135 grams, and carbohydrate, 54 grams—showed no ketosis; but on fasting they developed a ketosis. There was no retention of nitrogenous products in the blood. In the article no mention is made as to whether or not there are signs of arteriosclerosis.

Anitschkow,[29] feeding cholesterin, thinks he produced a condition which in respect to deposition of fat and the hyperplasia of the intima closely resembles human arteriosclerosis. In his experiment he first fed cholesterin alone; then gave the same feeding combined with the narrowing of the aorta by a ligature; then with the suspension of rabbits in an inverted position, with and without cholesterin feeding. He showed that mechanical interference which led to raised blood-pressure failed to produce arteriosclerosis, except when cholesterin was given at the same time. He also showed that less cholesterin was needed to produce these changes if a mechanical hypertension was present.

Scarff[30] fed rabbits with cholesterol in amounts of 0.2 to 0.7 grams for a period of two to six months: the rabbit killed at the end of two months showed no arterial changes; 1 killed at the end of six months and 2 at seven months showed definite arteriosclerosis.

Schmidtmann and Huttich[31] showed that, in cholesterol feeding of experimental animals, older animals showed a rise of blood-pressure and arteriosclerosis on much smaller amounts than young rabbits.

There seems to be no evidence that high-carbohydrate feeding results in changes in blood-pressure or in arteriosclerosis until there is an associated improper metabolism of fats.

Joslin,[32] in discussing the etiology of arteriosclerosis occurring in diabetes, believes the chief cause of the premature development

of arteriosclerosis in diabetes is due to an excess of fat, including obesity, which occurs frequently in these patients, as well as high fat in the diet. He agrees with Virchow, who found fat in the intima of larger arteries and concluded that fat in the form of cholesterol esters was deposited by imbibition and that the more fat there was in the blood the more readily it would be deposited. In the later stages calcium salts would be deposited with the cholesterol in the lower layers of the intima. Aschoff[33] verified this.

In summarizing his review of arteriosclerosis in *Physiological Reviews,* MacCallum[1] has to say, of the efforts which have been made in attempting to reproduce the disease, the following:

> "Every form of experiment has been performed in the attempt to reproduce the disease. These resolve themselves into three main groups:
>
> "1. Efforts toward affecting the vessel wall by mechanical means through elevation of the blood-pressure or otherwise.
>
> "2. Efforts toward producing lesions in the vessel wall by various poisons.
>
> "3. Experiments to show the effects of perverted or one-sided diets.
>
> "Of these, practically all that fall in the first two groups have failed to produce anything like human arteriosclerosis, while those of the third group have been more successful, especially when combined with mechanical disturbances. Of all the mechanical influences it seems that heightened blood-pressure is the only one of any importance, but that, acting alone, it produces little or no change. At most it seems to predispose to the imbibition of excessive lipoids in the intimal layer. Whether these lipoids themselves are the cause of the tissue hyperplasia remains to be determined."

The subject of this paper—that is, the possibility of the prevention of arteriosclerotic heart disease—depends, first, upon a knowledge of the cause. It is obvious that if the cause is not known, or only indefinitely known, there can be no possibility of making a definite effort to prevent the disease. From the review of the literature concerning the cause of arteriosclerosis, though it can be said that there is no definite proof in which there is not some controversy as to any single factor being a cause, still there are indications that certain controllable factors play a part in bringing about this disease. I think it has been shown that certain forms of arteriosclerosis are not due to senescence. Therefore, the proper attitude is not that arteriosclerosis, like a fate, must attack us all. There is certainly evidence to point toward, at least, a probability that infections, certain toxins and increased blood-pressure result in arteriosclerosis, and there is still further indication that a prominent factor in its production is faulty fat metabolism.

From a consideration of the foregoing beliefs as to the various causes of arteriosclerosis, it is readily seen that, with the exception of one or two, there are great divergences of opinion and almost nothing proven. It seems strange that concerning a disease as frequently met with as this, there should be so little known as to cause. Is it impossible for science to answer these questions, or may our lack of knowledge not be due rather to improper methods of investigation or to the inadequate use of proper methods of investigation? There is no reason for believing that the task is impossible. Rather we believe that proper methods adequately used will bring results.

There are two fundamental methods of investigation: the experimental and the historical. In using the historical method of investigation, statistical technique must be used; actually, proper statistical technique must be used when the experimental method of investigation is used if more than one or two experiments are carried out.

In considering the investigations which we have reviewed of the various causes of arteriosclerosis, we see that both the experimental and historical methods have been used. Some of these investigations, particularly the experimental, seem to have been well carried out, but many of them seem to have been considered inconclusive by the various authorities who have reviewed them. Some of the criticisms have been that in the experimental work in the production of arteriosclerosis much of the work has been done with rabbits. Rabbits are very prone to develop an arteriosclerosis, and for that reason are a prejudiced animal to use. Many of the experiments have been carried over too short a time and with an insufficient number of experiments. Some of the experiments carried on with animals are so different from what actually happens to man that the value of the results obtained in the animal, while true, is of little use in proving anything in relation to arteriosclerosis in man. For example: Adler,[34] by injecting enormous doses of nicotine in dogs was able to produce arteriosclerotic lesions. While this is an interesting fact, it bears very little relation to the question whether or not smoking of tobacco causes arteriosclerosis.

In voicing these criticisms I wish to put myself clearly on record as not decrying investigations made in the laboratory. It is obvious that many of the facts we need before we can have a clear understanding of the causes of arteriosclerosis must come from the laboratory.

Where historical investigations have been made, it would seem to me, if anything, greater errors in technique have occurred. In the literature, one is surprised at the excellent authors who quote the coincidence of one or two facts as rather conclusive evidence of the relationship of cause and effect in arteriosclerosis. A glaring example of such reasoning I find in an article concerning coronary thrombosis, its incidence, prevention and treatment, by a physician of international reputation. In discussing the fact that there may be a family tendency to coronary sclerosis and thrombosis, he makes the following statement: "Undoubtedly, certain families, and apparently certain races, are more subject to coronary sclerosis and thrombosis than others. Frothingham has reported coronary thrombosis in a man, aged forty-five years, whose father died at sixty-four, because of coronary thrombosis. Such familial and racial disposition points both to inherited influences and to habits of life." While Frothingham's case is extremely interesting, a simple coincidence like that means nothing in the solution of a problem such as the one before us, and the inclusion of such coincidences in scientific papers to bolster up a theory seems extremely unwise.

It seems to me another reason why so much good work has not brought greater results has been because of lack of coördination between clinical and laboratory studies. If we are to prevent heart disease we must know more of its cause. It is my belief that, with the proper consideration of the methods of investigation to be carried on and the proper coördination of such methods, we may hope to determine (1) the causes of arteriosclerosis, and (2) we may be able to remove certain causes and show that when these causes have been removed arteriosclerosis will be delayed or prevented. These investigations into cause must be carried on in the laboratory, in the clinic and by both together. The studies in the laboratory, it seems to me, should be carefully controlled experiments in the artificial production of arteriosclerosis by mechanical means, by infection and the results of infection, by toxins, by various types of feeding and, last, by influencing the metabolism of experimental animals. However great may be our hopes from the results which we will gain in the laboratory, I believe still greater information can be obtained from the properly organized clinic. Many of the questions which we wish to answer could be answered today if the thousands of careful observations made in the various clinics in this city on patients having arteriosclerosis had been collected in a

coördinated and uniform way, with the use of definite criteria, and if they had been placed upon a chart which would make them available for statistical study. Then the data collected on these thousands of patients in Philadelphia could be taken off these charts accurately by trained statistical clerks and the various attributes studied with a modern technique.

It is my belief that the final answers to most of these questions will come from the careful study of patients in ambulatory clinics over long periods of time, where these patients are not only carefully studied, but where accurate and uniform data are obtained by every available method and, after being selected, scientifically analyzed. This is no new thought. In 1845, Latham[35] wrote: "How rarely has it happened to any of us to have numerous individuals, the subject of any given chronic disease, so constantly within our reach that we could see them and inquire into their condition two or three times a year for many years together or for the whole of their lives." This was true in Latham's time, but it is no longer true. Clinics have been established in all the larger cities of this country for the treatment of chronic disease, notably heart disease, diabetes, gastrointestinal disease, thyroid disease and tuberculosis. Methods of follow-up have gradually been developed and it is no longer unusual for a physician at the end of a twenty years' experience to have followed the course of hundreds of patients with chronic disease. The bringing together of in-patient and out-patient services in many institutions is making it possible for the physician who has followed such patients in their ambulatory stages to follow their course in the wards and, where there is the best type of organization, to necropsy.

As one examines the record being developed in such clinics, one is struck by the fact that they are gradually being kept in such a form that it is possible to collect data from them. Furthermore, there is developing among the physicians in the various parts of our country a closer contact, and it is no longer unusual to see national bodies adopt uniform methods of nomenclature and criteria for diagnosis. Coincident with the development of such continuous observation, by coöperation with laboratories, special methods of investigation and study on such patients may now be made at any stage of the disease, and correlations made between such studies and the various phenomena.

In three large cities—Philadelphia, Chicago and New York—

coördinated studies in heart disease are being made along broad lines, such as those indicated. All of these, I believe, are being made, not in a single clinic or laboratory, but coördinatedly in various clinics and laboratories.

Physicians often marvel at the time and patience which a laboratory investigator expends in the development of a proper laboratory technique. Our work—that is, properly coördinated clinical and laboratory investigation in chronic disease—demands a technique which is surely as difficult to perfect and the development of which takes years. Quick results can never be expected. Time here must be counted in decades, and results hoped for after a generation of effort. To perfect such organization takes time, patience and tact; but surely the principle is right, and the start is made, and as the data collected under controlled conditions of large groups of patients is thus studied, there is reason to believe our knowledge of the causation of chronic disease will become greater. Then, and not until then, will we be able to state definitely whether or not it may be prevented.

In closing, I would again like to quote from Latham,[35] this time from the preface to his lectures on diseases of the heart:

"But there is a clinical history of diseases of the heart, as well as a clinical diagnosis. By their clinical history, I mean the notice of those conditions which, whether preceding, accompanying or following, may be deemed to hold with them some pathological kindred." . . . .

"But there are diseases of the heart which have a clear clinical diagnosis, but no clear clinical history, except of events which follow them; and these are the least amenable to medical treatment. The same signs which notify their existence, declare their incurability. What a gain will it be to mankind should observation hereafter discover that the conversion of the valves of the heart and the lining of the arteries into earthy matter, or cartilage, has its sure pathological origin in certain forms of disease in other parts, or in the constitution at large, which are both obvious and curable, or in certain habits and modes of living which can be rectified or avoided."

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DISCUSSION

Dr. Hobart A. Hare: After this very exhaustive consideration of the literature and subject in general, I do not think I can add very materially to it. From a fairly large hospital experience, I am firmly impressed with the idea that arteriosclerosis in the sense of that form of arterial disease in which we have what the speaker alluded to as corduroy vessels, sclerotic patches or pipestem vessels is met with in a large number of such patients. Contrariwise, in private practice, one meets with many patients who never manifest such changes, have far greater hypertension and who commonly suffer from angina pectoris. In looking over a long experience in my memory, but without having looked at notes, I would be almost willing to state that I have never met with a ward patient suffering from true angina pectoris, if we exclude cases that come in with coronary thrombosis; I mean the patients that have repeated attacks of angina pectoris, whatever that may be. No one who has been long in practice, seeing private patients, has not had many cases of angina pectoris. There is a difference between arteriosclerosis and capillary fibrosis. This is not a rather fine distinction, for the latter is a disease of the banker, the physician and the lawyer, who

work at high tension. The "corduroy artery," which is best seen clinically in the aged negro, is rarely seen in the high-type white man.

The other point that I would like to speak about is in reference to what the speaker described as softening changes in the middle coats of the vessel. This I have rarely seen in hospital practice, but a number of times in private practice. I could have brought here tonight several pictures showing temporal arteries very large in size and as soft as veins, so that if you put your finger on such a temporal artery it is of low tension, giving one a sensation of palpating a distended vein, the wall felt thin and the history of the case was that for many years there had been great hypertension followed by low tension due to gradual process of degeneration in the middle layers of vessels.

Dr. William D. Stroud: I cannot help but express my appreciation to Dr. Wyckoff for coming to Philadelphia this evening and talking upon the subject of the prevention of the degenerative types of cardiovascular disease. It seems to me his excellent review of the literature upon the subject of arteriosclerosis proves that medicine has not progressed very far in solving this problem during the past one hundred years, but I feel that the American Heart Association, the Cardiac Committee of the New York Tuberculosis and Health Association, of which Dr. Wyckoff is the chairman, and other heart organizations throughout the country, are beginning to bear fruit. Dr. Wyckoff has built up the largest and best-run heart clinic in the world at the Bellevue Hospital in New York, and I feel his work should stimulate us in Philadelphia to attempt to coöperate with the twenty-five heart clinics now being operated in our hospitals. It appears to me that many men in influential positions upon the boards and the staffs of our hospitals have not realized how much these heart clinics may mean in the ultimate prevention and relief of heart disease. Many of the chiefs of the medical staffs of hospitals in which clinical teaching is carried on, feel that it is necessary to have all patients with cardiovascular disease referred to the general medical clinic. Of course, we realize that it is necessary to have this type of patient come to the general medical clinic first, but after a diagnosis has been made, as Dr. Wyckoff has pointed out, in order to solve this problem, these patients must be given a much more careful study and follow-up than is possible in a general medical clinic. I hope that those of you who have listened to this excellent paper will coöperate with the heart clinics in the hospitals, and see to it that the patients, after study in the wards or in the general medical clinics, are referred for further follow-up in the heart clinics. If we are able to follow these patients and their families in our heart clinics, in order to discover if there is a familial tendency toward this disease, and in order to investigate other factors by carefully filling in the records supplied by the Cardiac Committee of the New York Tuberculosis and Health Association and the American Heart Association, possibly, in twenty-five to thirty years, this information may lead to further knowledge as to the causes of arteriosclerotic cardiovascular damage and how it may be prevented.

RESEARCH IN RELATION TO PREVENTIVE MEDICINE*

By WM. CHARLES WHITE, M.D.
UNITED STATES PUBLIC HEALTH SERVICE

I APPRECIATE the honor of presenting to you one of the J. M. Anders lectures, both because of my long friendship with Dr. Anders and because of what his gift represents to your Society.

In presenting the problem of *research in preventive medicine* before a group of physicians, we must take for granted that there is an interest in the pursuit of knowledge, the attainment of which often may change the character of the physician's practice. Research may result in the reduction of the market for one kind of service, and in raising the market for another within a short period of time. It may even interfere with established business, but this is a process of evolution which always attends the growth of knowledge in every field. In our case of physicians, if research promotes the welfare of man and reduces suffering, we cannot fail to become enthusiastic about it and reconstruct our methods to environment of progress. In a period of enthusiasm in every line, however, I am afraid that too much that is simple mimicry passes for original research.

The practices of preventive medicine fall into two great active groups:

1. Those preventive procedures which are carried out on the individual for his future welfare, such as vaccination against smallpox and the injection of toxin-antitoxin for the control of diphtheria.

2. Those procedures applied to the physical environment of the individual to improve his welfare, such as sewage disposal, pure water supply, pure food products and mosquito destruction.

Of those procedures that are applied to the individual for the prevention of disease only two stand alone in the assured position of success, vaccination against smallpox and immunization against diphtheria. If we review how these came about and inquire if they give any suggestion as to future methods of progress, we may

* Read April 3, 1929

find that they offer, by contrast, a reasonable approach to the way in which we can use to best advantage our own equipment.

Vaccination against smallpox came as the result of the chance contact of one type of intelligence with past observations. There were many faults in Jenner's reasoning, but, by verifying reports that a person having had cowpox was immune to smallpox, he produced a practical procedure for the prevention of smallpox in man which has changed little in one hundred and forty years. At the same time his conception of the transfer of horsepox to the cow and thence to man has never been proven. We have improved the methods of procuring the vaccine and administering it to man, but the working fundamental agent remains almost as elusive as it was in Jenner's time.

The history of diphtheria control is another story. In the fall of 1890 the *Berliner Medicinische Wochenschrift*, of December 4, carried an announcement by Behring and Kitasato that they had discovered antitoxins for diphtheria and tetanus toxins. Comparatively little attention was paid to this announcement. But, in contrast to the story of smallpox vaccine, the discovery of diphtheria antitoxin was the result of proving many facts. In 1821 Bretenneau established diphtheria as a clinical entity. In 1883 Klebs described the diphtheria bacillus. In 1889 Roux and Yersin described the existence of a soluble toxin, and in 1890 Behring and Kitasato made their announcement of antitoxins both for diphtheria and tetanus toxins. Roux, in 1891, made the first practical application of diphtheria antitoxin for the cure of human cases, and Michaelis and Schick announced, in 1912, the skin reaction to the toxin of the diphtheria bacillus on which is based our present test for the production of immunity. 1913 saw von Behring propose the mixture of toxin-antitoxin for the production of immunity, and in succeeding years Park and Zingher and the workers at the Hygienic Laboratory of the U. S. Public Health Service brought this into successful use. A few years ago Remar found that the action of formaldehyde on the toxin would produce a much less toxic substance than the original diphtheria toxin, but equally effective in producing an antitoxic substance when injected into a human. This substance is known as "toxoid."

In comparison with the success of smallpox vaccination and diphtheria toxin-antitoxin, although one came largely by chance and the other after a series of concentrated scientific efforts to

deduce the facts, tuberculosis would be considered as a partial failure, even though many of the same men responsible for the success of diphtheria took part in the study of tuberculosis, notably Koch and Behring. Many advances came in the latter half of the nineteenth century, which was really one of the greatest periods of Renaissance in medicine. You will recognize the names of Emil Fischer, Paul Ehrlich, Robert Koch, Louis Pasteur, Lord Lister and Virchow, who were at the height of their brilliance at this time, and around whom were gathered many notable students.

Robert Koch, who had already discovered the tubercle bacillus and who was called "the father of modern bacteriology," a few months before Behring and Kitasato published their work with diphtheria, announced a cure for tuberculosis. He was director of the institute in which Behring and Kitasato were carrying on their experiments, and his report on tuberculin was partly based in principle on the work which Behring and Kitasato were doing. Koch, working with tuberculosis, on the one hand, and Behring and Kitasato with diphtheria, on the other, believed that they had found a primary law in the relation of bacterial life to animal life. Koch was considered infallible by the majority, and the whole world went wild over his announcement. And yet tuberculin, rising like a rocket in prominence, had within a year practically vanished as the cure it was announced to be. It came into importance again with von Pirquet, and again subsided, only to break forth in our own day with renewed vigor. We are still working with Koch's tuberculin, which undoubtedly does possess a great truth which, by some failure in the human machinery of Koch's own day and since, still eludes us. Koch's observations may still prove him greater than his partial failure would suggest.

Diphtheria antitoxin pursued an almost unbroken course of successful evolution, and Behring and Kitasato have taken their seats among the mighty. Smallpox vaccination secured for Jenner his fame because of his accurate observations on what proved to be the truth. Tuberculin, however, was forced into a longer cycle of world events by a premature anouncement of its worth. Probably it has not yet reached the peak of its value, nor Koch himself been ranked according to his accomplishments.

This short outline of the working of human machinery seems to me to indicate that there are two prime factors in man's recognition of himself as a contender for supremacy. There is something ludi-

crous in the thought that man is a contestant for the position of supremacy when he does not even understand the chemistry of the simplest forms of life—bacteria. Two factors will always operate, chance and the step-by-step evolution of man's thought as it conforms to certain laws of the universe. Jenner, in a large measure, demonstrated the operation of chance, and Behring and Kitasato the slow evolution of thought. Koch demonstrated both. He followed the tedious process of accurate experimentation, checking one discovery against the next, in his work on the tubercle bacillus. But with tuberculin he took a chance that his theory and principle were sound before he had checked them sufficiently.

Never before in the history of the world has there been so vast a sum of money devoted to research as there is today. The income of several thousands of millions of dollars is expended annually, and I am sure a large part of this income is wasted. In a day when research has become a fetish chance is the lure to many; it rarely brings success.

The task of spending a small sum of money annually for research in tuberculosis was accepted by a small committee, which was forced to decide between chance ventures and logical procedures. It decided in favor of the latter, and this decision required as a preliminary step the production of a plan of work which soon resolved itself into a comparative chemical study of the different strains of the tubercle bacillus family. In this family four or five well-defined strains of the bacillus appear—human, bovine, avian and the timothy grass bacillus, which is similar but nonpathogenic. The lepra bacillus belongs also to the same classification of acid-fast bacteria.

Before this plan of work could be carried into effect, however, the brains to solve the problems in the various fields of research into which the main plan would ramify had to be found. A careful study of available students was made and their interest secured in solving the problems that arise. Contrary to the principle of building an institute and gathering into it from widely scattered localities students to man it, the National Tuberculosis Association, which is responsible for the research described here, has left the students where they are and provides them only with technical assistants, extra apparatus and travel expenses to conferences with their colleagues and to meetings where they may correlate their own work with the work of other students in the same large problem.

In this way a human machinery for the purpose of solving research problems in many different fields is put into operation with a minimum of overhead expense and a maximum of experience and ability.

For the actual plan of study it was determined that if the difference in the active chemical constituents of the bacteria of the same could be demonstrated, this might furnish the key to the different inherent quality of each strain producing disease in different animal groups. You will see that this is an endeavor to understand the chemistry of the simplest life forms. It is possible to grow each strain on the same medium in which no organic substance is a part, and which can be put into glassware of a constant chemical nature, without change in its constant condition of temperature, moisture or light. So far as we know, all the variants have been removed, and as a result of the growth of one or other strain of the bacillus on this medium everything that is isolated is part of the life process of that strain.

The object of this comparative study is to differentiate the factors responsible for the difference in the various strains of one family of bacillus. It was necessary, of course, to have one strain as the base against which to compare the others. For this base strain, a human tubercle bacillus, it has been found that it manufactures several specific types of chemical substances:

Albumin apparently divided into (*a*) water-soluble albumin, concerned in the skin reaction; (*b*) and acid-soluble albumin, the function of which is yet unknown; and (*c*) an alkali-soluble albumin, the function of which is also unknown at the present time.

Lipins, which stimulate the multiplication of the monocyte cell in which the tubercle bacillus grows as a parasite.

Sugars, which differ in character when attached to the *albumin*, the *lipins* or when free.

The *albumin* fractions probably differ only quantitatively in the different strains, although they may have certain qualitative differences. The *lipin*, or fat fraction, may differ quantitatively only, but probably they differ qualitatively as well. The *sugar* fractions may prove to be the most important chemical variants of the different strains of this group of bacilli. (Illustrations showing the variations of the different strains of bacilli in contrast to each other, the different fractions obtained from them and their action on normal and infected animals were thrown on the screen.)

Only as we are able to find the chemical units functioning in the closely related strains of bacilli of this one family group does it seem possible to advance further into the domain of the unknown. These simple forms of life have a chemistry of their own. They exist in families, and the contrast in the chemistry of the individuals offer seemingly the surest step toward an understanding that will advance preventive medicine. Such a procedure is a logical one, in which chance is reduced to a minimum and yet not robbed of its function. If chance finds the solution to the immediate problem of tuberculosis, the money expended will still have been employed in gaining fundamental knowledge in the warfare of man against bacteria, a warfare which seeks the primary chemical and physical laws involved.

DISCUSSION

Dr. James M. Anders: I am sure the Fellows and others present have enjoyed this splendid presentation by Dr. White. As he intimated, and as we as physicians probably all know, we owe the principal advances in preventive medicine to laboratory research workers. The history of the control of the acute communicable diseases, including some of the chronic diseases to which Dr. White referred, such as tuberculosis, is a most interesting story. I think it is especially interesting to note that the first active and important step in active immunization against acute communicable disease was taken by Lady Mary Wortley Montague, who, in 1717 to 1721, introduced into England from Turkey vaccination against smallpox. Of course the discovery of Jenner, three-quarters of a century later, overshadowed this primary step, he having announced, in 1798, the discovery of the attenuated virus with which to vaccinate against smallpox. Again three-quarters of a century or more passed before Pasteur gave to the scientific world his vaccine to protect from anthrax. Only a few years later, he extended the same principle to rabies in animals and hydrophobia in man with success. Then followed in rather rapid succession the discoveries (to some of which Dr. White referred) of the specific causes of certain communicable diseases and vaccines, and also sera to protect against them. Now the debt—and I am saying this for the benefit of the lay people who are present here tonight—the debt which the public owes to laboratory research must ever remain unpaid, and the research workers who gave their very lives in attempts to control certain of the communicable diseases—I am thinking now of Reed, Goldberger, Noguchi and others—are and should be regarded as the real heroes of their day and generation.

There is one aspect of the subject under discussion to which I think reference should be made: President Hoover, in his inaugural address,

said that the discoveries of science had opened up a new era in public health, that there were sections of this country and groups of people throughout this country suffering from diseases the eradication of which was merely a matter of administration and the expenditure of moderate sums. Now this statement implies what health officials well know, that our scientific discoveries are far in advance of our performance; in other words, the discoveries long antedate their practical application to human uses. One reason why the College is holding these annual meetings in the interests of public health and preventive medicine is to bring about public sentiment in favor of more prompt application of the scientific discoveries to human welfare, because we cannot proceed more rapidly in this matter than is permitted by public opinion.

I must say, again, I think the papers of the evening have been of great interest and also highly conservative in tone.

PROPHYLAXIS IN CHILDHOOD*

By JOHN C. GITTINGS, M.D.

In looking over the pediatric literature of the eighteenth and nineteenth centuries it is interesting to see the value which the relatively uninformed physicians of those days attached to measures for prevention of disease. Today the physician who is not fully alive to these possibilities is in danger of sacrificing his high status in the estimation of his community.

The present accepted and proven methods of prevention may be very briefly considered from the pediatric standpoint.

Prenatal care and the avoidance of injury at birth belong to the province of the obstetrician. Lues in the child would be largely preventable were it possible always to institute early and rigorous treatment of the mother. The importance of the mother's diet for the child's intrauterine development, particularly in the anti-rhacitic factors, is no longer debatable. Careful analysis of the effect upon the child of the various stresses and strains of parturition is pointing the way to the avoidance of some of the serious birth injuries.

It is unnecessary to consider the importance of cleanliness and asepsis in the avoidance of miscellaneous contagions, such as thrush, conjunctivitis, wound sepsis, etc. Specific prevention is now beginning to bulk very largely in the practitioner's daily work.

The value of toxin-antitoxin in the prevention of diphtheria is one of the most securely established facts in preventive medicine and its use should be strongly urged for every child. From six to twelve months is the best age, and in the late spring or early fall the best time for its administration. If the history shows any evidence of asthma or stubborn eczema it is safer to test for sensitivity before giving the first injection. Four to six months after the toxin-antitoxin injections have been given, a Schick test should be done to determine whether immunity has been acquired. If not, a second course of injections will be almost uniformly successful. The Schick material must be freshly mixed and tested for potency. The only

* Read, May 1, 1929.

disadvantage of toxin-antitoxin injections is that they may sensitize the patients to horse serum.

The status of prevention in scarlet fever is marred by the fact that the injections often cause serious reactions, and that we are not yet certain that the protection will last more than two or three years.

The use of convalescent serum in the prophylaxis of measles is now on a well-established basis. If blood from a recently convalescent patient is used, a dose of serum from 2 to 5 cc., according to the age of the recipient, will prevent measles in 95 per cent of cases, if given from three to five days after exposure. Larger doses, 5 to 10 cc., may be used for these exposed longer than five days. If measles is not entirely prevented, it will probably be more or less mitigated in 50 per cent. When the donor is a healthy child a Wassermann test is hardly essential.

The difficulty of securing donors and of preparing the serum suggested the use of whole blood from parents. Thirty cubic centimeters of whole blood removed from a parent who has had measles and injected at once intramuscularly has somewhat the same effect as convalescent serum, although it is not a complete preventative unless used early. Theoretically, it is safer to have a preliminary Wassermann test done on the parent. A mild attack of measles has the advantage of conferring active immunity where complete passive immunity induced by serum is short-lived.

In the same way immune serum may be used in the case of mumps and of varicella.

Vaccine prophylactic therapy for pertussis is probably of value if given early, but its results are by no means uniform or trustworthy.

The administration of low-virulence tubercle bacilli by mouth to newborn infants, as advocated by Calmette and Guerin in France, is not yet generally accepted as a safe procedure. The theory is to effect a localized mild tuberculous implantation which will not progress to clinical disease but which will stimulate resistance to virulent infection from human sources. It was intended only for such infants as could not be removed from a definite tuberculous milieu. Separation of the newborn child from all contact with open cases of tuberculosis still remains the most dependable means of preventing tuberculosis in early life.

Of the prevention of typhoid fever or smallpox it seems hardly necessary to speak. The limitation of effectiveness of the typhoid prophylactic seems to have been reduced to three years at best.

There is reason to believe that a single injection yearly after three years will perpetuate protection.

Recently there have appeared in literature, chiefly from abroad, a few instances of encephalitis which have followed smallpox vaccination. Obviously this may prove to be a real calamity unless the cause is discovered and removed. Apparently infants are much less susceptible than older children and adults, and there is at present not the slightest reason to withhold vaccination of infants in this country.

It is becoming customary to give tetanus antitoxin for every wound, regardless of the circumstances. Were the injections entirely innocuous, there would be less objection, but apparently reactions are more severe with this serum than with any of the others. It should never be used without previous tests for sensitivity. It would also seem desirable to limit its use to punctured or deep wounds, or those which cannot be promptly and thoroughly cleansed.

The prevention of hydrophobia requires quick action. If the circumstances show any suspicion of the biting animal having been rabic, the prompt examination of its brain for negri bodies is essential When this is not feasible, the preventive inoculation should be given at once.

Marasmus used to be a common diagnosis and cause of death. At autopsy, most of these infants showed no lesions sufficient to account for death. In some of these instances a suppurative otitis and mastoiditis, through the accompanying toxemia, may have been the cause; in most, however, the fault lay in the feeding. Today, given reasonably intelligent coöperation on the part of the mother and an adequate economic status, the vast majority of infants should escape marasmus. Next to the improvement in the milk supply, the most important factors in this saving of life have been the determination of the child's caloric needs on the basis of his expected —not actual—weight, rational methods of preparing milk for feeding, recognition of the importance of vitamins and of the dangers of too heavy clothing and of poor ventilation.

The use of citrous-fruit juices or tomato juice in sufficient quantity prevents scurvy. The juice of oranges which have been kept in cold storage long after being picked is not as efficacious as that of the fresh crop and should be given in larger doses.

Rickets may be largely but not absolutely prevented in all patients by the use of potent cod-liver oil, begun at the end of the third or

fourth week of life. Sunbaths in summer and ultra-violet light treatments once a week in winter, in conjunction with cod-liver oil, will almost entirely prevent rickets, provided the general diet and hygiene are suitable. A few patients, particularly among Negroes and Italians, may prove to be partially resistant. The use of activated ergosterol promises to be even more effective than cod-liver oil in the prevention of rickets. It is important to remember, however, that ergosterol does not contain vitamin A, as does cod-liver oil.

Spasmophilia and tetany—the chief causes of convulsions in infancy—can be prevented by early and adequate use of anti-rachitic measures.

Tonsillitis and quinsy can be prevented by complete tonsillectomy, but sore throat involving other lymphatic elements may still occur, although it is not as severe, as a rule, as true tonsillitis.

Apparently some cases of spasmodic stenosis of the pylorus are accompanied by, if not caused by, hypertrophy of the thymus. The syndrome of functional stenosis can, in such cases, be prevented by the irradiation of the thymus.

Cœliac disease can probably be prevented if more attention is paid to the diet of children in their second year. Since these children suffer primarily from starch indigestion, the habit of feeding large amounts of starch for supper as well as breakfast and the free use of unstrained vegetables are to be avoided in infants who evidence any tendency to intestinal indigestion.

Certain individuals seem to be prone to develop the rheumatic syndrome. The child who has a tendency to develop tonsillitis, myalgia and growing pains, who tires easily and who may be somewhat anemic, requires careful supervision, especially in the late winter and spring. All infected foci should be cleared up, the child should avoid chilling and physical exhaustion and should have occasional courses of salicylates alternating with iron and cod-liver oil. Constipation should be avoided and the diet and daily regimen supervised. In spite of this, rheumatism and heart disease will occur in some, but the incidence can be lessened by such measures. Maude Abbott insists that patients with congenital heart disease require all these prophylatic measures, since an endocarditis engrafted on a congenital lesion is not unusual.

Chorea is less amenable to preventive tonsillectomy than is rheumatism.

The ascending route of infection in some cases of pyelitis is

definitely to be accepted. The avoidance of introducing infection into the vagina of infants, especially those with diarrhea, by carelessness in bathing probably has a practical importance. Infection from toilet seats, also, is to be avoided.

Nutritional anemia is the commonest form in infancy. Persistence too long on a strictly milk diet and the lack of iron-containing foods are the usual remediable causes.

Tuberculous adenitis is due in large part to the use of raw milk from heavily infected tuberculous cows. Since the adoption of pasteurization of market milk in cities and the introduction of certified milk, tuberculous adenitis is becoming a clinical rarity.

Simple goiter in early adolescence usually can be prevented by the exhibition of iodine: 2 grains of sodium iodide three times a day for a week, twice a year, seems to replenish the content of iodine in the thyroid gland.

The infant who shows a tendency to exudative diathesis, by patches of moist dermatitis back of the ears and on the cheeks, often has a low tolerance for cows' milk fat. Reduction of the amount of this fat in the diet and an increase of cod-liver oil to supply the deficiency of vitamin A will at times prevent a serious outbreak of eczema.

Finally, several evenings could be spent on the most important questions related to child training. No one who has seen the results of a rational regimen, contrasted with those obtained by the oversolicitous or the behavioristic methods, can doubt that much of the individual's happiness and health, both in childhood and adult life, depends upon the parents sense and knowledge, or lack of them. To see the spoiled, fretful, undernourished child transformed into the antithesis of these, within a few weeks, by separation from the family and introduction into a suitable regimen, is a demonstration that can scarcely be misinterpreted.

It is probably true that students and physicians as a class are not as interested in prevention as they are in cure. The chief reason for this, it seems to me, is that the effects of preventive practices are not obvious. The cure of diphtheria by antitoxin is a striking, tangible and satisfactory result. On the other hand, the child who is given toxin-antitoxin may never have developed diphtheria and even a satisfactory Schick test gives negative results. Only those physicians who study statistics can get a true idea of what prevention really means, and he who is alert to the possibilities of prevention not only has the satisfaction of a clear conscience but also wins the real confidence and affection of the families that he treats.

THE PREVENTION OF RESPIRATORY INFECTIONS IN CHILDHOOD*

By HOWARD CHILDS CARPENTER, M.D.

This subject is of particular importance to those of us who are interested in child health, because respiratory infections are so much more common in the early years of life than at any other age.

Are respiratory diseases infectious? They are so conceded by almost all authorities. There are only a few who do not agree.

Cheney, in the *American Journal of Public Health,* states that colds are not an infection but an acidosis. His theory is that the common cold is due to a disturbance of the acid-base equilibrium, and that the contributing factors in producing a cold are poorly-balanced diet, lack of exercise, fatigue, constipation and infections elsewhere in the body. He believes colds can be prevented by maintaining the alkaline balance, through proper diet, exercise and the careful use of sodium bicarbonate.

Maughan and Smiley state: "Facts are already at hand which suggest the possibility of relating our winter and spring incidence of colds: (1) to our winter and spring deficiency in vitamin intake; (2) to a disordered vitamin metabolism in the human, directly due to a lack of solar radiation during the dark months of winter when the majority of the population are out in the open but little."

Vaughan believes that acute coryzas are due to different types of protein sensitization. He believes that the absorption of unbroken proteins through abnormal nasal mucous membranes produces a sensitization.

These opinions are, however, exceptional. I desire to emphasize that, in order to succeed even in a moderate degree in the prevention of respiratory diseases, we must not only believe, but teach the public, that they are infectious.

Peter Heinbecker reported an investigation of isolated Polar Eskimos, who had had no respiratory diseases, but in forty-eight to

* Read, May 1, 1929.

seventy-two hours after slight contact with visitors from the outside world, the Eskimos developed acute respiratory infections, even when the visitors had, themselves, no acute infection.

Droplet infection is relatively unimportant, compared to hand-to-mouth infection, and we should appreciate how rapidly infections may be spread in this manner. Vaughan says: "Imagine, if you will, that each person shakes hands or comes into intimate personal contact with but ten people a day. On the following day each of these ten, come into intimate contact with ten others. This process need be but continued seven days, to reach a million people."

Chapin vividly describes hand-to-mouth infection: "Probably the chief vehicle for the conveyance of nasal and oral secretions from one to another is the fingers. If one takes the trouble to watch for a short time his neighbors, or even himself, unless he has been particularly trained in such matters, he will be surprised to note the number of times that the fingers go to the mouth and the nose. Not only is the saliva made use of for a great variety of purposes, and numberless articles are, for one reason or another, placed in the mouth, but for no reason whatever and all unconsciously the fingers are with great frequency raised to the lips or the nose. Who can doubt that, if the salivary glands secreted indigo, the fingers would continually be stained a deep blue; and who can doubt that, if the nasal and oral secretions contain the germs of disease, these germs will be almost as constantly found upon the fingers?

"All successful commerce is reciprocal, and in this universal trade in saliva the fingers not only bring foreign secretions to the mouth of their owner, but there, exchanging them for his own, distribute the latter to everything that the hand touches. This happens not once, but scores and hundreds of times, during the day's round of the individual."

It is to be regretted that public-health officials throughout this country have not sufficiently stressed the fact that pneumonia is a transmissible disease. That it is so is shown by the frequency with which two or more children are infected in the same family. Under these circumstances the pneumococcus obtained from each of the sick patients is almost always the same type, and the members of the family who are not sick are frequently carriers of this same type. Isolation is important, not only to protect all the members of the household but also to prevent them from becoming carriers and thus spreading the disease beyond the confines of that particular home.

Grant has shown that in 500 families in which there was an infant suffering from a cold, in 290 of these families there were other members who also had colds; and in 500 families in which there were well babies there were only 180 of the families in which some member had a cold.

The Streptococcus hemolyticus is frequently found in the noses and throats of normal children. In one study the Streptococcus hemolyticus was found in two-thirds of the children from throat cultures and in 97 per cent of the tonsils removed from the same children. They are certainly much more common in the throats of children who have tonsils than in those in whom the tonsils have been removed. It would seem that this variety of streptococcus is found in greatest abundance deep in the crypts of the tonsils. The mere presence of these organisms in the tonsils is an argument in favor of the early removal of tonsils.

The ordinary bacteria obtained in cultures from the tonsils and the nasopharynx consist of the alpha and beta type of hemolytic streptococci, Streptococcus viridans, various types of pneumococci, hemolytic and nonhemolytic staphylococci, diphtheroids and Gram-negative cocci. Hemolytic streptococci are the most frequent and most important bacteria in the production of infection in the respiratory tracts of infants.

Polvogt and Crowe, in Baltimore, examined bacteriologically tonsils and adenoids at operation in 100 patients, and found in 91 per cent the Streptococcus hemolyticus and in 8 per cent the staphylococcus.

The most generally accepted theory as to why organisms, which may have been carried for weeks without producing any symptoms, suddenly become active, is that the resistance of the mucous membrane is reduced when there is a sudden lowering of the infant's temperature below normal, that is, when anything disturbs the heat-regulating apparatus. The large amount of body surface, compared to body weight, makes the young child more susceptible to the reduction of its body temperature.

Improper training of the skin to dissipate and conserve body heat when suddenly required, results in a quick chilling of the mucus membranes, reducing their normal protective action to pathogenic bacteria, with a resulting rhinitis. There frequently follows, from this seemingly trivial infection, one or more of the other severe respiratory diseases.

There can be no doubt that one of the chief reasons why colds are very common in infancy is the frequency of rickets, which in this part of the United States is a well-nigh universal disease during the first year of life. It has long been recognized that infants with rickets have a low resistance to respiratory infections.

There are also anatomical reasons why infants are susceptible to respiratory infections, such as the very minute size of the posterior nares; any slight inflammatory process will shut off nasal breathing.

The prevention may be summarized by stating that two factors are necessary for its accomplishment: The protection of the child from infection, and the establishment of immunity to infection. The first, to be accomplished through prophylactic hygienic care; and the second, through the correction of whatever condition renders the child susceptible. Prevention will be accomplished just as soon as public opinion is sufficiently aroused to demand it. Scientific medicine possesses the knowledge which, if put into effect today, would eliminate the morbidity from respiratory infections; but alas! ignorance is so widespread throughout our country that the best-informed of our citizens are unable to protect their children from dissemination of these diseases. May the day come, in the not distant future, when the carrier of infection will be ostracized from society!

In the prevention, the first step is to correct whatever pathologic conditions are already present in the nose and throat, as children with chronic upper respiratory disease are unquestionably predisposed to acute infections.

The prevention of respiratory infection becomes a family problem, because isolation of the sick in most homes is inadequate, and the problem must so be approached if success is to be obtained. It is also a school problem. Until we educate parents not to send their children with beginning coryzas to school, we will be unable, because of intimate contacts in the schoolroom, to prevent its spread. School teachers should dismiss all children with respiratory infections; but, on the other hand, the closing of schools is not an effective method of controlling respiratory epidemics.

Indoor living in the wintertime is one of the greatest factors in the production of respiratory diseases, which might well be called the "closed-window-complaint." To keep an infant in a room without sunlight is practically consigning that infant to respiratory disease.

Common contributing causes are excessive clothing of children, too warm homes, lack of unfiltered sunlight, insufficient outdoor exercise, wet feet and failure to put and keep children in bed for any and all acute infections, however slight. The child's fingernails should be cleaned daily and his hands washed before each meal.

Respiratory infections are spread by infected eating utensils, as demonstrated by Lynch and Cummings. Soiled linen and blankets should be disinfected; but masks, and nose and throat prophylaxis by sprays and gargles are not effective.

The prevention of colds from a public-health point of view divides itself into: (1) General measures, those affecting the entire population; (2) special measures, those affecting the individual. The first, includes such matters as health legislation, sanitary regulation, housing laws, the supervision of the food supply and the elimination of the smoke nuisance. The second comprises preventive measures fostered by the health officer and members of the staff of a division of child hygiene, which may be summed up in a broad interpretation of the term "health education." Health education is promoted by health news items in the public press, health bulletins, radio talks and lectures to parents, but chiefly by individual home contacts through public-health nurses and by personal interviews with physicians at health centers and hospital clinics.

In the reduction of respiratory diseases one of the most needed lessons, which can be best accomplished by health education, is the regulation of heat and moisture in homes.

Haynes wrote: "The regulation of the heat and humidity of the atmosphere of houses is important. Our houses are too hot. They are too dry. The room heated to 72° F, with a relative humidity of 50 to 60 per cent, has disastrous effects upon the respiratory mucous membrane, from which it abstracts moisture to partly make up its deficiency. It may be that adenoids are due to the artificial heating of our houses and their lack of moisture. They have become fearfully abundant in the half century or more during which central heating has been in general use. A house kept at 65° F., with a humidity of 60 per cent, will be a house comfortable in the coolest weather and be nearly free from respiratory disease."

It is well to remember that pneumonia occurs in premature and in newborn infants frequently, being often incorrectly diagnosed as atelectasis. This is an important reason why newborns should be protected at all times from sudden lowering of their temperatures.

This can only be accomplished by having a warm delivery room and by not carrying the infant from one room to another, as is often done, especially in maternity hospitals. Newborns are too long exposed for bathing and dressing purposes immediately after birth. They should not be bathed for at least four hours, and not then if their temperature is subnormal. I believe that all maternity hospitals should be equipped with a suction apparatus, to remove the secretions from the throats of newborns, in place of the too common method of wiping out the newborn's mouth with a finger. Also, too frequently, nurses with respiratory infections themselves are seen caring for newborns, which practice should never be tolerated.

Lincoln has found that there is a direct relationship between respiratory diseases and the amount of carbohydrate in the diet. We must, therefore, feed children on a balanced diet, one that does not contain an excess of carbohydrate and that avoids a vitamin deficiency during the winter months.

I believe that irradiation with an ultra-violet lamp once a week at 30 to 40 inches from the patient for five to ten minutes, not more than a mild erythema-producing dose, promises to be an effective measure in reducing the frequency of colds during the winter. Maughan and Smiley say a ten-minute irradiation of the naked body with the ordinary mercury-vapor lamp at a distance of 30 inches, once a week throughout the dark period of the year, resulted in reductions in the frequency of colds from 40.3 to 27.9 per cent. Barenberg, Friedmann and Green quote Eidinow to the effect that ultra-violet rays increase the normal bacteriocidal power of the blood 20 per cent. They, however, believe ultra-violet radiation is given too frequently and in excess, and that exposures of a less degree will accomplish better results, but their own efforts to prevent respiratory diseases failed. Hoffman suggested that the skin is one of the most important seats for the production of immune bodies, and he attributes the beneficial effects of heliotherapy to the antibody production therein.

It is to be hoped that the time will come when we will be able to successfully vaccinate against respiratory infections. Vaccines are now recommended by many observers as effective in raising the individual resistance toward the bacteria accompanying coryza. I regret to say that from my own clinical experience such immunization by vaccination has been very doubtful. The prevention of the respiratory diseases can be best accomplished by building up the resistance of the individual child.

DISCUSSION ON THE PAPERS OF DRS. GITTINGS AND CARPENTER

Dr. Frederick Fraley: May I, first of all, compliment the readers of these important papers and congratulate the College on the opportunity of hearing them. The subject has been covered so completely there is very little room for discussion. Several things occur to me which I would like to mention. First, the question of the use of tetanus antitoxin. I am continually finding myself confronted by the problem of the mother who wants me to administer tetanus antitoxin for the most trivial injury to the child, such as a brushburn, or a bruise from falling off a bicycle. Having seen some very severe reactions to tetanus antitoxin, I am being held back from administering it routinely, although I, of course, realize the necessity for it in punctured wounds and other serious injuries.

I would like to ask Dr. Gittings to say something about the use of irradiated food, concerning which we have all been receiving so much literature lately.

In regard to Dr. Carpenter's excellent and comprehensive paper, I might mention that I happen to be physician to a large country day-school and our difficulties in the prevention of respiratory diseases are very great. I had a personal experience some time ago which brought this home to me: There was a scarlet fever scare on the "Main Line," and I was asked by the headmaster of the lower school to examine every boy as a possible potential case or carrier. I spent one afternoon examining some 200 boys, and, while I did not recollect any particular instance where a boy coughed in my face, I know that twenty-four hours later I was down in bed with a grippy cold, presumably as the result of concentrated droplet infection.

Dr. Edward L. Bauer: It seems to me that the psychology of disease prevention makes for a situation like this: The commonest things we meet with every day are the things to which the public and, perhaps, the medical profession give the scantest thought. Recently, in a magazine, someone asked why the medical profession spent so much time on the study of cancer and leprosy, and one or two other conditions which are rare and horrible diseases to the mind of the laity, and yet paid no attention to the common cold, whooping cough and diseases of a kindred nature. The writer said he could find no record of any real research along these lines and no effort by the profession to prevent these common ailments. He then went further into a long harangue of the difficulties he had experienced with one or two physicians and pediatrists in getting them to pay any serious attention to his child with whooping cough.

It is true that the laity and, perhaps, a good many physicians do not regard these conditions other than lightly, and it behooves us if we are to make any progress in the prevention of the respiratory diseases, which are the bugbear of practice today, to insist upon the seriousness of the problem to both the profession and the laity. Perhaps progress will not be made until we can inculcate into the minds of the public the economic cost of

colds and other more serious respiratory infections. Of course, we are doing scientific and research work on whooping cough and other diseases, but we have not made the progress we should make and have made in other diseases. I did not hear all of Dr. Gittings' paper, but what I heard was impressive in the way in which he handled a large subject, covering much ground in a short time. It would hardly be fair to take up in detail many of the points made by the speakers because the time allotted does not permit a deep consideration of these various problems.

Dr. John F. Sinclair: I have been interested in both these papers, and wish to speak especially from the point of Dr. Carpenter's paper. In spite of the great frequency of hand and mouth infection, he made somewhat light, I thought, of the droplet infection. Perhaps he is right, but we at the Babies' Hospital have had the opportunity for the past eight years to watch the children who are in cubicles where there is not an opportunity for the child to get cross infection except as there enters the cubicle a doctor or nurse or other person. Strict aseptic technic is maintained, and yet in spite of every effort they do develop coryza. We occasionally have a more serious infection in the way of a tonsillitis, and sometimes it goes on to middle-ear infection. Aside from the upper respiratory infections, we seem able to protect the child. It, therefore, seems to me largely a matter of droplet infection, and it is almost impossible to be sure that every doctor and every nurse is absolutely free from infection. We do, as I said, maintain a rigid technic, the doctor and nurse washing their hands before leaving every room and changing gowns. It may be that the infection is from hand to mouth, but it seems to me that droplet infection is responsible for some instances.

Dr. Gittings (closing): Answering Dr. Fraley's question, I have not read of any definite studies on the use of irradiated food. It is obvious that it can be irradiated, but it is a question in my mind how long the effect would last.

As to droplet infection, it seems to me that it is always a temptation for the mother or nurse to talk to a child in close proximity to its face. Anyone who will take the trouble to observe will notice that, when talking a little while, droplets will emerge from the mouth. This is a thing I always warn mothers against—not to talk to the children while immediately over them. I think droplet infection is of some importance.

Referring to the gentleman, quoted by Dr. Carpenter, who believes that colds are due to lack of ultraviolet radiation, I would like to ask him why it is that suburned children, coming back from the seashore in the fall, get colds as soon as they return to the city?

CONGENITAL BONE SYPHILIS*

By EUGENE P. PENDERGRASS, M.D.

The diagnosis of congenital syphilis is frequently difficult because of the multiplicity of the clinical signs, no one of which is invariably present. We cannot depend upon the Wassermann reaction. The most reliable diagnostic procedure is the roentgen examination of the bones. If the child has congenital syphilis, the roentgenogram of at least some of the bones is almost invariably positive. In view of the increased interest which has recently been taken in the pathology of the fetus and the infant, and the fact that very few clinicians appreciate the value of the roentgen diagnosis in congenital syphilis, we have attempted to review the literature, correlate the normal and abnormal bone changes as studied histologically with those shown on the roentgenogram and as far as possible have divided the abnormal changes into stages for ease of interpretation and description. This paper has been limited to the early cases of congenital syphilis, and late syphilis (*syphilitica tarda*) will not be considered.

The roentgen appearances of the pathology of congenital syphilis are difficult to understand unless one has a thorough knowledge of the histology of bone development.

Development of Bone

In order that one may easily grasp the pathological process found in congenital syphilis, a brief description of the normal ossification of bone will be reviewed. The authors have procured this information in its entirety from Piersol's,[1] Schafer's,[2] Gray's[3] and Wimberger's[4] writings on this subject. It is appreciated that, at the present time, there are many among the experimental anatomists who believe that the entire chapter on the development of bone will have to be rewritten, because of recently evolved theories not known to the authors of our accepted text-books at times of writing. I have omitted, however, these revised conceptions of bone development

* Read May 1, 1929.

and have confined our efforts to an outline similar to that found in our text-books.

Ossification of bones takes place by two methods: *endochondral* and *intramembranous* bone development. *Endochondral* development is that process in which the primary ossification occurs in cartilage. By far the greatest number of bones found in the human skeleton develop from masses of embryonal cartilage. *Intramembranous* bone development is that process in which the primary ossification occurs within layers of connective tissue. The bones of the vault and most of the facial bones develop by this method. The two processes are so closely associated in the development of all bones that little attempt will be made to differentiate them; thus, for instance, in the same bone, ossification of the periosteal membrane is *intramembranous* bone development and ossification in the cartilaginous shaft is *endochondral* development.

There are two important processes in normal ossification of the long bones: (*a*) Growth in the length by epiphyseal ossification at the ends of the diaphysis, and (*b*) growth in thickness by periosteal and endosteal ossification. The epiphyseal ossification is much greater than the periosteal and is, therefore, usually the location of the greatest change when any pathological process tends to delay the normal development of bone.

In the embryo the diaphyses and the epiphyses consist of embryonal cartilage invested by an immature form of perichondrium or primary periosteum, from which proceed entirely the elements actively engaged in the production of the osseous tissue. The primary periosteum consists of three distinct layers: an outer or fibrous layer; an inner or osteogenetic layer, which is rich in cells, from which the bone elements (osteoclasts and osteoblasts) arise; and a middle or vascular layer, located between the outer fibrous and the inner osteogenetic layer, which plays an important future rôle in the blood supply of the bone.

The initial changes appear within the embryonal cartilage at points subsequently to be known as the *centers of ossification*, which are located about the middle of the shaft. The early changes are enlargement of the cartilage cells and the deposition of lime salts in the intercellular matrix. When the cartilage cells have acquired their maximum growth they begin to show evidence of impaired vitality. Coincident with these intracartilaginous changes the periosteum deposits a thin, peripheral layer of bone, and small bud-

like processes of osteoblastic tissue extend from the osteogenetic layers into the embryonal cartilage, having been preceded by bloodvessels. Accompanying this penetration of osteoblastic tissue there is an absorption of the less resistant cartilage cells in the center of ossification. This area of absorption ultimately forms a space, called the primary marrow cavity, which now occupies the center of ossification and contains the direct continuation of the cells of the osteogenetic layer of the periosteum. The tissue contained in the primary marrow cavity is called primary marrow, and it contributes the cellular elements upon which a double rôle devolves, to produce osseous tissue and to remove embryonal cartilage. Beyond the immediate limits of the primary marrow cavity the cartilage cells in turn repeat the preparatory stages described above, under the same influence; but, in addition, often exhibit a conspicuous rearrangement whereby they form columnar groups separated by calcified matrix. This belt is called the *zone of preparatory or temporary calcification* and is best seen at the diaphyseal ends of the bone.

For sake of brevity and ease of description, a longitudinal section through the long axis of the growing end of the bone will be taken as an example, and it shows the following layers of cells extending from the joint side toward the diaphysis: The epiphysis, before the appearance of a center of ossification, is made up (as in the diaphysis), entirely of cartilage, which is termed resting cartilage. The resting cartilage of the epiphysis constitutes the entire area up to the diaphysoepiphyseal junction. Just at the diaphysoepiphyseal junction there is a layer of cartilage in which the cells become increasingly larger and arrange themselves in columns extending down toward the diaphysis, the long columns of the cartilage cells lying parallel to the long axis of the bone. The cartilage cells enlarge, and the preliminary deposition of calcium takes place in the intercellular matrix in the portion nearest the advancing ossification of the shaft. This belt is called the zone of proliferating cartilage, or zone of temporary calcification, and is always definite as a sharp line of demarcation. Its regular arrangement, according to authors quoted by Wimberger,[4] depends upon the arrangement of the cartilage canals containing bloodvessels, which percolate between the layers of cells in the proliferating cartilage in a regular series of branches at right angles to the long axis of the cartilage. The branching bloodvessels, which run parallel to one another and axially upon ends from the marrow cavity, break through the cross dividing walls

around the cartilage cells (the absorption of the cartilage cells being accomplished probably through the agency of *some cells that accompany the bloodvessels*), so that longitudinal walls of calcified cartilage remain free and isolated in the marrow cavity (which now extends largely throughout the diaphysis). On these longitudinal walls the osteoblasts arrange themselves (and form young osseous tissue), being brought there by the bloodvessels from the bone-marrow. Thus a column of cartilaginous tissue is replaced by osseous structure. This framework constitutes the primary spongy or cancellous bone, and this area is termed the frame-work marrow zone. It is called primary because, subsequently, all or most of it is absorbed by osteoclasts and then reformed by osteoblasts. The reformed spongy bone is called secondary spongiosa, a permanent structure. The spaces between the osseous trabeculæ are filled with marrow, which contains bloodvessels, osteoclasts, osteoblasts, lymphoid tissue and other specialized cells.

Summary of the Zones from Joint Toward Diaphysis. (*a*) Resting cartilage; (*b*) proliferating cartilage; (*c*) zone of temporary calcification; (*d*) frame-work marrow zone (spongiosa). An excellent summary of the gross appearance of the above zones has been outlined by Holland[5] which is as follows:

"Cut surface of a longitudinal section of a fresh, normal, long bone of the infant: From an epiphyseal cartilage toward the diaphyses, the following zones can be recognized:

"1. White, flat, hard cartilage, corresponding to the portion in which growth in length and breadth of cartilage proceeds.

"2. A zone of more slaty and translucent, very slightly bulged, softer cartilage, corresponding to the portion of the cartilage in which as the first preparatory changes for ossification from the diaphysis, the cells have multiplied, have arranged themselves in columns and have enlarged at the expense of the matrix.

"3. An opaque yellow (often almost white) line corresponding to that portion of the cartilage in which, as the final preparatory change, the matrix has undergone "provisional" calcification, but into which the vascular loops from the medulla have not yet advanced.

"4. The deep-red medulla of the diaphysis. Further, on close inspection, a few delicate vessels may be recognized in the cartilage, close to the diaphysis. *Microscopic* examination shows that the cartilage is permeated by vessels which lie in canals, which have the

following arrangement: Vessels pass transversely inward from the perichondrium at regular intervals, which become wider as the diaphysis is approached, to anastomose in the midline; other vessels pass vertically from these transverse arches, uniting the transverse arches with one another and ultimately with vessels of the diaphysis. The vessels increase in size toward the diaphysis; in the rib the largest vertical vessels lie in the center of the cartilage.

"The coloration mentioned above becomes to a large extent obscured by hemolysis in the macerated fetus. The yellow line of provisional calcification remains distinct. It stretches unbroken from one side of the bone to the other. It varies a little in depth—that is, in measurement from the epiphysis to diaphysis—at different ages, in different bones and in different portions of some epiphyses, being deepest when the growth is most active. Its measurement is almost invariably $\frac{1}{2}$ mm." (This corresponds to the sharp line at the end of the diaphysis, as shown in the roentgenogram.)

After the center of ossification develops in the epiphyseal cartilage the arrangement of the zones is slightly different. It is always well to bear in mind *that, except on the side of the epiphysis which is turned toward the advancing ossification of the shaft, the cartilage cells do not* become arranged in long columns in the manner described above. Otherwise, we have assumed that the ossification of the epiphysis proceeds in a manner similar to that of the diaphysis. We have found no authentic statement as to the origin of the ossification center in the epiphysis. In attempting to solve this problem, a study of diagnosis in Schafer's[27] diagrams suggested that a vessel derived from the diaphysis carried the essential elements. In case of epiphyseal separation or other disturbance of this circulation, transverse chondral vessels assume the rôle. Therefore, the zones from the joint line would be as follows: (*a*) resting cartilage; (*b*) center of ossification; (*c*) resting cartilage; (*d*) columnar or proliferating cartilage cells; (*e*) temporary zone of calcification; (*f*) framework marrow zone (spongiosa).

Bloodvessels. The generous blood supply of bones is arranged as two sets of vessels, the *periosteal* and *medullary*. The former constitutes an external network within the periosteum, from which, on the one hand, minute twigs enter the subjacent compact substance through channels (Volkmann's canals) communicating with the Haversian canals, within which they anastomose with vessels derived from the medullary system; additional vessels, on the other hand, pass to the cancellated tissue occupying the ends of the bone.

Roentgenologic Appearance of Normal Bone

If one examines a roentgenogram of a long bone before the development of centers of ossification in the epiphyses, the following features will be observed: The diaphysis appears as a cylinder, with a thick, dense wall or cortex in its middle portion. This gradually fades into a thin line at the diaphysoepiphyseal junction. It surrounds a less dense cavity, the marrow cavity, which at the ends is broken-up by the regular network or trabeculation, called the spongy bone. At the diaphysoepiphyseal junction there is a narrow, unbroken, dense line, about 1 mm. in width, which is called the zone of temporary calcification and corresponds to the limit of advancing ossification. It is *most important* because of the changes which occur here in such diseases as rickets, scurvy, congenital syphilis and acute leukemia. This is often called the epiphyseal line in medical literature, but this term has been applied in such a variable and confusing manner that we recommend the term *diaphysoepiphyseal line*, or possibly *metaphysis*. The epiphyseal cartilage is not usually seen in the roentgenogram. After a center of ossification develops, a faint shadow of the epiphyseal cartilage in addition to the ossified center can usually be seen on the roentgenograms showing excellent soft-tissue detail. The periosteum of normal bone is not visible; if it is visible, there is always some underlying pathological change.

Congenital Syphilis

Pathology. There has been a considerable amount of investigation relative to the pathology of congenital syphilis, the most outstanding of which has been that by Wegner[6] and Holland,[5] and we have quoted freely from their writings.

In 1870, Wegner[6] described the changes occurring in congenital syphilis, mainly as variations from the normal occurring at the diaphysoepiphyseal junction, and he called this condition *syphilitic osteochondritis*. Syphilis may, however, give rise to inflammatory changes also in the diaphysis at a distance from the epiphysis, or in the periosteum (*periostitis syphilitica*).

The effect of syphilitic osteochondritis upon the normal zones, previously described varies according to the severity of the injury to the normal tissues by the spirochetes and their toxins, and these changes have been divided by Wegner[6] into three stages, depending entirely upon the degree.

Osteochondritis

First Stage. The temporary zone of calcification is increased in thickness, the cartilage cells continue to proliferate and there is no cessation of the normal changes except retardation of the ossification process. This obviously results in the yellow zone of temporary calcification becoming abnormally wide, and it may measure as much as 2 mm. or more in width. Holland[5] states that "*in early lesions there may be no recognizable abnormality;* the junction of the epiphysis and diaphysis, then, remains regular and unbroken. When the increase of the zone of calcification is slight and no other changes are present, then, diagnosis, even with the microscope, is difficult, unless the spirochetes can be demonstrated."

Ossification of the temporary zone of calcification is checked to a large extent throughout most of the diaphysoepiphyseal junction, but it may continue at the sides of several of the *larger* vertical vessels which unite the epiphysis and diaphysis. In these particular regions, therefore, the temporary zone of calcification becomes narrow, and consequently the diaphyseal border of the zone is notched, irregular and serrated in appearance. Wegner[6] states that this zone has a pinkish-white, glistening appearance and is very brittle. These changes can be readily demonstrated by the roentgenogram, as will be shown later.

Summary: (*a*) increased growth of cartilage cells; (*b*) temporary calcification increased; (*c*) ossification decreased.

Second Stage. The cartilage-cell proliferation becomes more marked toward the joint. There is increased calcification of the intercellular cartilage matrix; the zone of temporary calcification now measures about 4 mm. in width; the ossification process is still retarded. Holland's[5] description of this stage is excellent and is quoted in its entirety:

"Owing to curtailment of the normal vascular supply, portions of the epiphyseal cartilage may become degenerate and not undergo provisional calcification and subsequent ossification. The vertical vessels, however, which unite the cartilage with the diaphysis, are relatively large vessels, and the blood supply from these is less likely to be cut off. Provisional calcification and subsequent ossification usually proceed, therefore, around some, at any rate, of these.

"In consequence, narrow processes or broader tongues of red marrow project from the diaphysis into the epiphyseal cartilage and

alternate with tongues of cartilage which project into the diaphysis. The line of junction of the epiphysis with the diaphysis then appears dentate, and the zone of provisional calcification follows the irregular line of interlocking teeth.

"Further, as growth proceeds, the level at which provisional calcification should normally take place may reach transverse chondral vessels of which the blood supply has not been interfered with. Around these vessels, in the epiphysis beyond the degenerate portions of cartilage, calcification and subsequent ossification take place in due course. This leads to the occurrence, in the epiphyseal cartilage at a distance from the main epiphyseal limit of diaphyses, of red streaks and dots which are each bordered by a narrow zone of yellow calcification. Transverse chondral vessels have become visible to the naked eye and, moreover, have become surrounded by a visible zone of calcification. Now, not only is the junction of the diaphysis with the epiphysis dentate, but transverse zones of provisional calcification are seen at different levels. The disturbance of the normal pattern is extreme.

"The cartilage lying upon the deepened zone of provisional calcification may not be interrupted by vertical vessels surrounded by provisional calcification. Then calcification preparatory for ossification commences in the cartilage about a transverse vascular arch at the time it should normally appear at this arch. When this takes place two zones of provisional calcification, separated by a zone of cartilage, are seen. Ossification may then proceed toward the epiphsis from this transverse vascular arch. In this way a more remarkable appearance is produced: a yellow (usually irregular) line of provisional calcification is followed by a zone or red marrow, in which osseous trabeculæ can be felt with the point of the scalpel, and this red marrow is separated from the red diaphyses by a second the original, yellow, abnormally deep zone of provisional calcification."

Wegner[6] compares this stage to rickets. The zone has a bluish, transparent color, very soft consistency and cuts like gelatin.

Summary. (*a*) Further increase in the cartilage cells (zone of proliferation); (*b*) further increase in the zone of temporary calcification; (*c*) ossification decreased in the zone of primary spongiosa; (*d*) occurrence of second zone of temporary calcification, just distal to primary zone of temporary calcification; (*e*) diaphysoepiphyseal junction more serrated and irregular.

Third Stage. In this stage there is a further progression of the osteochondritis. In addition, there is evidence of diaphysitis and periostitis.

Added to the changes seen in the second stage, there is a definite fibrosis present; in fact, fibrosis is seen by the microscope in all but the slightest and earliest lesions. Holland's[5] conception of this stage is as follows:

"Fibrosis may affect the marrow of the metaphyses (diaphyso-epiphyseal junction), or of the canals in the cartilage or of both. In advanced, intense inflammations, fibrosis is followed by the development of a dense granulation tissue. In the metaphyses, formation of such granulation tissue results in necrosis with erosion by osteoclasts of the trabeculæ of calcified cartilage and bone. The punched-out areas and the irregular rarefaction of the diaphysis, as seen on the roentgenogram, is the result of the process. When the cartilaginous canals are affected they become greatly widened. The granulation tissue may undergo caseation and softening. The epiphyses may become separated from the diaphyses by a transverse zone of granulation tissue in which trabeculæ of calcified cartilage and bone have been eroded, or the epiphyseal cartilage may be divided by a zone of granulation tissue. If such granulation tissue undergoes softening the osseous structure may be entirely destroyed, which may result in an infraction of the diaphysis or the epiphyseal cartilage is divided completely at a short distance from the epiphyseal diaphyseal junction. Even if the granulation tissue has not softened, partial or complete separation at such spots is likely to recur during life or in the manipulation required for removal of the bone."

Fibrosis is of greatest assistance in the macroscopic and microscopic recognition of syphilitic osteochondritis. It is the earliest pathological change in congenital syphilis. If the process progresses, the next pathological change is granulation-tissue formation due to the disturbance of the blood supply. When slight fibrosis is present in the metaphysis, the marrow in the metaphysis appears to the naked eye more compact and paler than in the remainder of the diaphysis. The affected metaphysis may feel gritty when tested with the point of a scalpel. It may be pink, gray or pale yellow, owing to the presence of numerous yellow trabeculæ of calcified cartilage in a gray fibrous matrix. More advanced fibrosis appears slaty-gray or yellowish, gelatinous and slightly bulged, and feels

soft, owing to the erosion of calcified cartilage and bone. When slight fibrosis is present in the epiphyseal cartilage the vascular canals are more conspicuous than normally. When advanced fibrosis is present, pink, gray or yellowish strands interrupt the cartilage in the sides of the canal.

Wegner[6] states that, after granulation tissue has replaced the normal vasculature, there may be actual pus formation, which corresponds to the softening described by Holland.[5] This stage probably corresponds to the condition recognized and described by Parrot,[7] in 1871, as Parrot's pseudoparalysis, which is always associated with epiphyseal separation in congenital syphilis. Valleix,[8] in 1834, reported a case demonstrating this process, the condition not being recognized until after autopsy.

The coherence of the tissues at this zone is very weak, and has been described as an epiphyseal separation. Our conception, is, however, that the resultant deformity is due to an infraction of the diaphysis just proximal to the epiphyseal cartilage.

Summary: (*a*) abnormal cartilage cell proliferation which causes slight swelling of the epiphysis; (*b*) widening of the zone of temporary calcification, with occurrence of secondary zones of calcification; (*c*) retardation of the transference of calcified cartilage into bone; (*d*) fibrosis and granulation tissue, with subsequent necrosis in the marrow at the diaphysoepiphyseal junction, which causes weakening of the bone at this point, with possible subsequent infraction of the diaphysis (or the so-called epiphyseal separation); (*e*) the outermost cells near the perichondrium are more regular and the calcified zone is more regular than near the center; (*f*) the chondral and vascular canals are enlarged, the vessels are few and irregular.

Diaphysitis

It has been our feeling that possibly diaphysitis occurs more frequently than is commonly stated. A number of fetuses or infants that we have had occasion to examine roentgenographically show nothing but an increased density of all of the bones. It is an experimental fact that decreased vascularization of the diaphysis causes increased calcification. Realizing this, we believed that the appearance we were seeing was an early stage of diaphysitis, which might ultimately become areas of focal necrosis if the disease were allowed to progress.

Virchow[9] called rickets "parenchymatous bone inflammation." Wegner[6] called congenital syphilis "osteochondritis" or "cartilage inflammation." In rickets there is increased vascularization of the tissues with diminished vascularization and increased calcification, which may be general. Holland[5] says: "Focal areas of syphilitic inflammation occur with considerable frequency in the medulla of the diaphysis at a distance from the epiphysis. This fibrosis is associated, first, with cessation of deposit of bone, and, later, with erosion of trabeculæ of bone and calcified cartilage present. In early stages the areas of fibrosis are seen by the naked eye as paler pink areas in the red marrow of the diaphysis; in later stages the granulation tissue is slaty-blue or yellowish, frequently gelatinous, and the affected area feels soft."

Periostitis

This lesion usually accompanies advanced osteochondritis. Apparently it rarely occurs alone. A layer of bone (young osteoid tissue), red marrow and (rarely) granulation tissues is deposited outside the cortex under the periosteum. It is readily recognized by the naked eye and is similar to the same zone which occurs in rickets.

Congenital syphilis of the bones is due to the local presence of spirochetes or their toxins. The older the child the fewer the bones that are affected. In the fetus the infection is widespread but not necessarily general; not all of the bones are affected—the femur, tibia, humerus and rib being the sites of election. Alexander[29] has demonstrated syphilis in the scapulæ, vertebræ, skull and pelvis with less frequency. Another feature that should be stressed is the occurrence of various stages of infection in the same fetus or infant, one bone showing the first stage and another the third stage.

Syphilis in the adult is not necessarily transmitted to all of the offspring, as shown by van der Bogert[10] and Jeans.[11] Van der Bogert reports syphilis in one of twins, the other child being entirely normal. It is not known whether the early manifestations of congenital syphilis heal and then later develop the manifestations found in late syphilis.

Roentgenologic Considerations

In 1911, Holt[12] stated that in a syphilitic fetus, a stillborn child or one dying soon after birth, the changes in the bones are more

uniformly present than any other lesions. It has been recognized that bone lesions are associated frequently with congenital syphilis, and may be the only evidence of the disease. Valleix[8] in 1834, Wegner[6] in 1870, Parrot[7] in 1871, Taylor[13] in 1874, and later writers, as Fraenkel,[14] Wallace[15] and many others, noted and described the pathology of the bone lesions of congenital syphilis. The pathology of the condition had been thoroughly studied prior to the advent of roentgenology. Since that time, however, relatively little effort has been made to correlate the pathological and roentgenological appearances.

Shipley, Pearson and their coworkers[16] regard positive Wassermann reactions as specific, but negative Wassermann reactions are no longer allowed to free the newborn child of luetic stigmata until after the age of two to four months. They state, further, that the clinical diagnosis of syphilis in the newborn is difficult, since the clinical symptoms of the disease may be, or in fact are, usually entirely absent in the child until several weeks after birth. Moreover, a mother without a single clinical manifestation or any serological indication of spirochetal infection may give birth to a luetic infant.

In spite of these observations, numerous articles[17-20] have recently been written on the diagnosis and treatment of syphilis, in which the roentgen manifestations are either not considered or are only casually mentioned. It is indeed surprising that the roentgen examination is not used more often as an aid in the diagnosis of cases suspected as being congenital syphilis.

The incidence of congenital syphilis is high enough to justify every roentgenologist in thoroughly familiarizing himself with the roentgen manifestations. Christie[21] evidently realized this in the preparation of a recent excellent editorial on syphilitic osteochondritis. The disease is not limited to large metropolitan centers. Browning[22] states that the incidence of congenital syphilis in the group studied by him was 10 per cent. Williams[23] analyzed 10,000 consecutive pregnancies in which there were 705 stillbirths: of these 26 per cent had congenital syphilis; of the children born alive, 3.5 per cent had syphilis. These figures were determined by the presence or absence of positive serological tests; therefore, the incidence would probably have been found higher if the infants had been studied roentgenologically. Shipley, *et al.*,[16] in an examination

of 200 infants, stillborn or dying soon after birth, found 25 per cent with roentgen evidence of syphilis.

Recently Davidsohn[24] has collected statistics from all over the world (Germany, Czechoslovakia and North America), which show that from 2 to 5 per cent of infants have congenital syphilis. Findlay[25] found bone lesions in 25 per cent of cases of congenital syphilis studied by him. Dennie,[26] in a study of 50 cases, stated that 40 per cent had no other signs except the bone lesions. Burke[27] makes the startling statement that in England there are 30,000 stillbirths and deaths from lues in children annually.

Congenital syphilis may be demonstrated on the roentgenogram as osteochondritis, periostitis or diaphysitis, just as it can be demonstrated pathologically. Either one or all of these conditions may be found in the same patient. Osteochondritis may be divided into three stages. Periostitis and diaphysitis usually accompany the third stage of osteochondritis, or they may occur individually as the only evidence of the infection, but this is relatively rare. Periostitis is rarely seen in the stillborn; more often it occurs in the *older infant,* one that is using the muscles of the leg and arm, or, in other words, an active child. This observation was also made by Shipley and Pearson[16].

As stated above, congenital syphilis of the bones is not a general systemic infection of the infant, but is due to the local presence of the spirochetes or their toxins. Sutherland and Mitchell[28] suggest that ofteochondritis is a secondary rather than a tertiary lesion, because os its ephemeral character. The older the child the fewer the bones that are affected. In the fetus the infection is widespread, but is not necessarily general. Therefore, it is not usual to find all of the bones affected. Syphilis may involve one or all of the bones of the body, and it should be borne in mind, therefore, that no examination can be regarded as negative until the entire skeleton has been examined. The point of election for the lesions is usually in the bones in which there is more active normal growth. Most authors—including Wegner,[6] Findlay,[25] Shipley[16] and Alexander[29]—agree as to the sites of election, at least as far as osteochondritis is concerned, and are given in the order of frequency: Lower end of the femur; lower end of radius; upper end of tibia; upper end of femur; upper fibula; upper humerus; and other bones with less frequency.

Osteochondritis

The three pathological stages of osteochondritis of Wegner have previously been described.

Epiphysitis. The subject of epiphysitis has not been discussed thoroughly by any of the pathologists that we have had occasion to review, and we have been unable to find any reference to the effect of congenital syphilis on the center of ossification in either pathological or roentgenological literature. The appearances of epiphyseal involvement herein described are, therefore, based entirely upon the study of our own series of cases. For convenience, epiphysitis will be divided into three stages and discussed with osteochondritis.

First Stage. 1. Swelling of the epiphyseal cartilage, due to the proliferation of the cartilage cells. This may or may not be evident on the roentgenogram, the interpretation thereof depending upon the possibility of comparisons with the uninvolved opposite member. This, of course, is before the development of the center of ossification. After the development of the centers in either the epiphysis, tarsal or carpal bones, changes may take place within the ossified portion. The first abnormal appearances are localized areas of rarefaction, giving the impression that holes have been made in the osseous center. The periphery of the center becomes increased in density, this appearance being very similar to that of the ring described by Wimberger in scurvy.

2. Increase in the width and density of the zone of temporary calcification. Normally the zone of temporary calcification is evidenced on the roentgenogram by a regular, unbroken line of increased density, 0.5 to 1 mm. in width at the diaphysoepiphyseal junction. In congenital syphilis it is increased to approximately 2 mm. in width.

3. Ossification of the calcified zone or primary spongiosa decreased except around developed vessels, thus making an irregular border more evident on the diaphyseal side of the zone of temporary calcification.

Second Stage. 1. Further increase in the size of the epiphyseal cartilage. Here, again, this finding is relative and can only be demonstrated after comparison with a possible normal on the opposite side. After the development of centers of ossification in the epiphyses and tarsal bones, the changes discussed under Stage 1 have

advanced. The localized areas of rarefaction are larger and more pronounced. The line of increased density around the periphery of the osseous center increases in density and width, but at one or more points the dense line may be interrupted, due to the extension of the rarefied areas to the periphery.

2. The zone of temporary calcification is increased up to 4 mm. in width.

3. Ossification decreases, giving a more serrated and irregular appearance to the zone of temporary calcification, quite evident on the diaphyseal side of the zone and to a less extent on the epiphyseal side. This irregular appearance is due to ossification proceeding around some of the remaining larger vessels which extend from the diaphysis into the epiphysis.

4. Occurrence of a second zone of temporary calcification on the epiphyseal side just distal to the original zone of temporary calcification. The most likely explanation of this finding is that given by Holland,[5] which is to the effect that the cartilage cells lying upon the original zone of temporary calcification may not be interrupted by vertical vessels surrounded by provisional calcification. In consequence of the growth that proceeds, the level at which temporary calcification should normally take place reaches the transverse chondral vessels, the blood supply of which has not been interfered with; then calcification preparatory for ossification begins in the cartilage about a transverse vascular arch, giving the appearance of two zones of temporary calcification separated by a zone of cartilage from the original widened zone of temporary calcification.

Third Stage. In this stage there is a further progression of the process detailed for the second stage. In addition, evidence of periostitis and diaphysitis may be noted.

The changes in the osseous centers of the tarsal bones and the epiphyses are most characteristic in this stage. One can easily see the localized rarefied areas in the osseous centers. The original zone of increased density around the periphery of the center of ossification is surrounded by a narrow zone of lessened density apparently of osteoid tissue. As far as we have been able to discover this appearance is characteristic.

Another important change in this stage is the zone of decreased density proximal to the zone of temporary calcification. This is due to the formation of granulation tissue in place of the usual

normal vascular supply, with subsequent decrease in ossification and absorption of the old bone. If the process progresses, the bone becomes weak enough to allow infraction of the diaphysis, first observed by Fraenkel,[14] and causing the condition called by Parrot[7] "pseudoparalysis." Veeder and Jeans[30] found the incidence of pseudoparalysis to be 14 in 100 cases. Findlay[25] states that it may be taken as an axiom that "the loss of power in a limb of an infant of under six months of age is due to syphilis."

Diaphysitis. Under this heading we have included inflammation of the bones of the vault, vertebræ and pelvic bones, except at the epiphyseal regions, and the long and short-long bones. We have attempted to divide the process into two stages, depending upon the severity of the process. It should be remembered that diaphysitis may occur alone or it may be associated with either osteochondritis or periostitis or both.

First Stage. Stage of irritation, evidenced by increased density of some or all of the bones. This may be the only diagnostic sign of syphilis. At first we were inclined to overlook this finding; but as it occurred frequently in some bones in infants that had other stigmata of the disease, we felt justified in suggesting this as the first stage of diaphysitis. Lovett and Wolbach[31] called attention to the fact that if the degree of reaction to the spirochetes or their toxins was slight, there would be bone proliferation; if severe, there would be necrosis. The bones of the skull, pelvis and vertebræ may show these changes as definitely as those seen in the long bones.

Second Stage. In this stage the process is much advanced, and for convenience we will discuss the process in the various bones separately.

In the vault, the process may involve the inner or the outer table, or both, and is evidenced as a rarefying or necrosing osteitis. Léri and Cottenot[32] emphasize the fact that osteitis of the inner table of the skull is an important diagnostic sign.

When the short-long bones, pelvic bones and vertebræ are involved, the appearance may be evidenced as rarefying osteitis or focal necrosis. The pathology of the condition is the formation of fibrosis, interference with blood supply, the formation of granulation tissue, cessation of deposit of bone and, later, erosion of the trabeculæ of the bone and calcified cartilage already present. The roentgenogram shows an irregular rarefaction or focal necrosis or both.

In the long bones, the process is much more evident. Here the roentgenogram shows either an irregular rarefaction or focal necrosis or both, sometimes appearing as an ordinary osteomyelitis. Baetjer and Waters[33] call attention to the diagnostic importance of the punched-out area near the zone of temporary calcification. They also state that luetic infections nearly always produce new bone. While this is true to a large extent in older children, *it is not so evident in the young infant.*

Another important feature which we regard as evidence of diaphysitis has been noted by Shipley and Pearson.[16] In many of the long bones the spongiosa near the end of the diaphysis is *cone-shaped,* and is apparently separated from the thin dense cortex by a narrow zone of decreased density, giving it the appearance of being suspended unattached within the cortical cavity.

Periostitis. This manifestation usually accompanies advanced osteochondritis. Apparently it rarely occurs alone, and is usually seen in older infants and children. The appearance on the roentgenogram is due to the abnormal deposition of new osteoid tissue beneath the periosteum. In all long bones and the vault this deposition of the bone frequently gives an appearance of perpendicular striation on the roentgenogram. This is because the bone is deposited around the vascular channels extending from the periosteum into the shaft, and it is, therefore, at right angles to the long axis of the bone. Fraenkel[34] states that periostitis is usually present in the ilium, but cannot be demonstrated on the roentgenogram. We have noted that there is rarely evidence of periostitis on the posterior aspect of the femur, possibly because of the arrangement of muscle attachments.

On the outer table of the skull there sometimes develop nodes, first described by Parrot,[35] and which are called "Parrot's nodes." It is probably an end-result of periostitis. Scott[36] noted the fact that rarely periostitis, elsewhere, may develop into osteophytes as an end-result.

We have regarded dactylitis as evidence of periostitis in the short-long bones. According to Holt,[12] it usually occurs under one year of age, and attacks the metacarpals and metatarsals more frequently than it does the phalanges. The appearance on the roentgenogram is that of a shell of bone surrounding the affected diaphysis, extending from the zone of temporary calcification at the base to the

beginning of the epiphyseal cartilage distally. In the first metacarpal and first metatarsal it extends from the epiphyseal cartilage at the base to the epiphyseal cartilage at the distal end. Curiously enough, the new bone is laid down horizontally to the long axis of the shaft, similar to tuberculosis.

Conclusions. Congenital syphilis must be differentiated from rickets and scurvy, but time will not allow a discussion of this phase of the subject.

In closing, I would like to state that this work represents the combined efforts of Dr. Ralph S. Bromer and myself.

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DISCUSSION

Dr. Ralph S. Bromer: I feel there is nothing to add, as Dr. Pendergrass covered the subject most thoroughly. He asked me, however, to say something on the differential diagnosis, which, because of lack of time, he was unable to cover.

The two other very frequent diseases of infancy and childhood are rickets and scurvy. Osteochondritis luetica is a disease of infancy and the newborn, and is most common immediately after birth or in the first few weeks of life; the earliest occurrence in the case of rickets is three months, the incubation period of scurvy is six months. So this age incidence is a great help in making the differential diagnosis. As to periostitis: Inasmuch as rickets also shows periosteal manifestations, and subperiosteal hemorrhages occur in scurvy and, during various stages of the three diseases the appearance of the periosteal changes may be similar, the diagnosis can only be made by the recognition of the pathological changes in the endochondral

areas of growth. The widespread involvement of the diaphysis in cases of syphilitic diaphysitis, as demonstrated on the slides this evening, will serve to differentiate it from acute osteomyelitis, which rarely shows such extensive involvement.

The question of the diagnosis of healing syphilis in combination with rickets in the same patient is a relatively frequent problem. We are now working on this and hope to report progress soon. The combination of scurvy and healing syphilis is, I believe, much less frequent.

A CLINICAL STUDY OF MIDLINE CEREBELLAR TUMORS IN CHILDREN*

By FRANCIS C. GRANT, M.D.

In a recent review of the cases of cerebellar tumors in children passing through the Neurosurgical Clinic of the University Hospital, the frequency with which these tumors were found in the mid-cerebellar region was striking. Furthermore, the majority of these tumors in this location were of one pathologic group, the medulloblastomas. Since, therefore, one certain type of neoplasm appears to originate in a particular area of the cerebellum, it seems worth while to consider the clinical features connected with a tumor of this variety in this location. Are these symptoms of such uniformity that their appearance justifies a preoperative diagnosis of the position and type of the lesion? If such a diagnosis may be made with certainty, what is the proper treatment and the prognosis?

This report is based on a series of 15 children harboring tumors verified as medulloblastomas. The term medulloblastoma has recently been adopted by Bailey and Cushing in their regrouping of the glial tumors based on the staining reactions developed by Cajal and Hortega. In all the cases here recorded the lesion was situated in the midline between the cerebellar hemispheres and arose from the roof of the fourth ventricle.

These tumors seem, on gross examination, fairly well circumscribed, but more detailed study always reveals areas of infiltration in the surrounding cerebellar tissue. Microscopically the predominant cell is irregularly round or oval in shape, with scanty cytoplasm and large oval nucleus containing abundant heavily staining chromatin material. On low-power study the cells appear as a loose structureless mass in areas forming pseudorosettes or elsewhere arranged in strands suggesting a spindle-cell sarcoma. Bloodvessels are numerous and much of the fine connective-tissue stroma of the tumor is confined to the walls. Mitotic figures and other evidences

* Read May 1, 1929.

of rapid growth are easily demonstrable. By proper staining methods with Hortega's fourth variant both spongioblasts and more highly differentiated cell types may be identified and the internuclear material shown to be made up largely of the processes of embryonic glia cells.

The history these children give is so uniform as to have definite significance. At the onset the average age was eight years, the oldest fifteen, the youngest three years. There was little or no difference between the sexes. As these tumors develop in size they at once impede the cerebrospinal fluid circulation. As a result the earliest impressive symptoms are those of pressure—vomiting attacks with headache. These bouts of vomiting and headache are usually considered by the attending physician as due to gastrointestinal disturbances and the child treated accordingly. Curiously enough, the vomiting and headache come on intermittently, as though the tumor blocked the flow, caused pressure symptoms, and then the fluid forced itself past the obstruction, with relief of tension.

Since the cranial sutures in young children have not completely closed, as pressure develops compensatory separation occurs and the head enlarges and becomes boxlike. And very fortunate it is that the sutures do separate as pressure develops, for otherwise many more of these children would be totally blind before the true nature of the condition is recognized. Enlargement of the head relieves pressure on the optic nerves to some extent and prevents prompt and early visual loss. Furthermore, at this age visual loss does not mean much to the patient and as it develops gradually does not cause much complaint. Little by little the parents notice that the child is becoming clumsy, it falls more easily, the gait is uncertain. Over one-third of the cases in this series developed a diplopia which was often the first bit of evidence leading to the suspicion that the vomiting and headache might be due to an intracranial rather than a gastrointestinal condition. Finally, an examination of the eye-grounds is completed, which reveals a choking of the disks, confirming the presence of intracranial pressure. Admission to the hospital usually follows. The average period for the development of symptoms prior to hospitalization was five months, the longest period ten months, the shortest a single month.

On first examination a very shrewd guess may be hazarded as to the position and nature of the lesion by anyone who has seen many

of these cases. The enlarged head with the definite cracked-pot percussion note; the marked cerebellar gait, with ataxia more pronounced in the trunk and legs than in the arms; the hypotonia and areflexia; the suboccipital tenderness, and often slight retraction of the head, in a child with a history of sudden onset of pressure symptoms, presents an unmistakable clinical picture. But that the process of our education in this matter was slow is evidenced by the fact that in two of the cases in this series a diagnosis of suprasellar lesion was made and an operation carried through to expose this region, with disastrous results.

With regard to the cerebellar symptoms, it is the impression on the part of those who examined these children that the trunk and legs are definitely weaker and more ataxic than the arms. The extremities were usually equally involved. A unilateral predominance of cerebellar symptoms was unusual. A tendency to fall backward was particularly noted in 6 instances. Considering the position of the tumor in the midline, involving the vermis; the fact that the ataxia was most marked in the trunk and legs, would bear out the claims of recent investigators that this area of the cerebellum had a specific control over these regions. Nystagmus was noticeable by its absence in 8 of these 15 cases. That nystagmus may be absent in midline cerebellar lesions should be remembered, for it has always been considered almost a pathognomonic sign of cerebellar disease. The lack of this symptom went far toward clinching an incorrect diagnosis in one of the patients under consideration.

In two cases cerebellar fits were noted, with retraction of the head and tonic spasms, with stiffness and rigidity of all extremities.

The accessory examinations, Bárány tests, *x*-ray, eye-ground and perimetric tests gave no information of value. In fact, the Bárány tests, done in 7 patients, placed the lesion above the tentorium in 4, reporting the cerebellum as negative. Fundoscopic studies merely confirmed the increased intracranial pressure by describing choked disks. The perimetric tests, when possible, simply showed concentric contraction of the fields. *X*-ray studies revealed convolutional atrophy, separation of the sutures, and in 3 cases, because of marked erosion of the sella, concluded that the tumor might be in this region. That posterior fossa lesions causing a block and dilatation of the third ventricle may thereby cause disappearance of the clinoid process should always be kept in mind. Furthermore, pressure in

should be reserved as after-treatment to surgery. Decompression plus removal of enough tumor to unblock the fluid circulation, and then roentgenization to control recurrence, is the best line of attack at present available.

DISCUSSION

Dr. Frederic H. Leavitt: Dr. Grant's report concerning his clinical study of brain tumors in children is similar in many respects to the findings in my recent review of some 350 verified brain-tumor cases. In this series the proportion of juvenile to adult tumors was essentially the same as Dr. Grant has reported, and the two outstanding types of lesions were the midline cerebellar medulloblastomas and the suprasellar tumors. Approximately 60 per cent of all the tumors in children that I investigated were in the cerebellum.

Dr. Grant has stressed the fact that the symptoms of brain tumors, especially in very young children, appear to come on suddenly, and it is his opinion that this is due to a release of intracranial pressure by the separation of the sutures. I believe that Dr. Grant is correct in this surmise, because in nearly all the cases I have studied the history has been that the patients state that there was a sudden onset of symptoms, generally of headache, vomiting and disturbance of locomotion. A child is not at all prone to give evidence of failing eyesight until vision is markedly diminished. An ophthalmoscopic examination of the eye-grounds at that time will generally reveal a pronounced condition of choking and of irremediable pathology.

It is my opinion that the incidence of brain tumors in children is much greater than the average physician suspects, and when young children complain of the triad of symptoms noted above, plus an obscure neurological picture, it is best to suspect the possibility of one of these two predominating types of cerebral newgrowths as being the offending agent.

In support of the fetal-rest theory of the genesis of newgrowths, I wish to again quote the case of brain tumors occurring in identical twins at the Children's Hospital. These children died within a year of each other of a tumor of the vermis of the cerebellum. The theory that identical twins occur from the splitting of a single fertilized ovum, and the occurrence of identical tumors in an identical situation in identical twins, may be construed as evidence supportive of the theory that these growths had as their nidus the neoplastic "rest" of embryonic cells left *in situ* in the early migration of cells from which eventually develops the cerebellum. During the past two years the literature has quite frequently made reference to the occurrence of similar diseases in identical twins, particularly the recent paper of Dr. S. A. Kinnear Wilson, of London, read before the meeting of the American Neurological Society in Washington, D. C., last year.

Dr. Grant has forcibly stressed the urgency for the general practitioner to realize the frequency with which these tumors occur in children, of the necessity for as early a recognition of their presence as possible, and the realization that with the surgical means at our disposal and the aid that may be given by deep *x*-ray therapy the prognosis for alleviation and possible cure of these patients is fairly good.

OBSERVATIONS ON LONG-DISTANCE RUNNERS*†

By BURGESS GORDON, M.D.

AND

The Late JOHN C. BAKER, M.D.

(From the Medical Service of Dr. Thomas McCrae and the Department for Diseases of the Chest, Jefferson Hospital.)

The possibility that certain untoward effects may occur following prolonged exercise has been considered seriously in recent years. The interest is due largely to the increasing number of endurance contests (swimming and running) and the fact that a number of prominent athletes have succumbed to heart disease and pulmonary tuberculosis. Critical data, however, to prove that physical effort is injurious or shortens the expectancy of life of the normal individual are not easily obtained. Obviously it is as difficult to estimate the potential endurance of an individual as it is impossible to predict the degree of resistance to infection. The problem is confused further because of the frail appearance of many athletes who perform with unusual ability over a long period of time. Malnutrition, upper respiratory infection and oral sepsis are not uncommon, and yet so far as determined longevity compares favorably with nonathletic individuals of similar station in life. It has been suggested as an explanation for untoward effects that a pathologic state existed before the onset of strenuous effort and that exercise exerted merely a precipitating influence. So far as we are aware this impression has not been finally proved or disproved.

Abraham,[1] MacKenzie[2] and Bainbridge[3] have reviewed the literature on the physiology and certain clinical aspects of muscular exercise. It appears that the majority of studies referred to have been made at the onset or immediately following exertion. Apparently there have been few opportunities to study the phenomena of recuperation or the results of early athletic training and competition.

* Read, June 4, 1929.

† A part of the expense for this investigation was defrayed by a grant from Mr. S. W. Leidich and the E. T. Bedford Fund.

The tabulation of untoward effects has been acquired largely through questionnaire sponsored by universities and athletic associations. It will be several years, perhaps, before adequate data are obtained for final analysis.

In the past the study of disease has depended to a considerable extent on the presentation of data for follow-up and evaluation in later years. One of the attempts to apply this plan of investigation to a study of the effects of marathon running was instituted at the Peter Bent Brigham Hospital in 1923.[4,5,6] In the first series of studies (1923) no cardiac hypertrophy resulting from many years of prolonged vigorous effort was noted, and immediately following the race there was no evidence of dilatation. (In a few instances the hearts were temporarily smaller than at the beginning of the race.) In the second series of studies, concerned with an examination of the chemical constituents of the blood (1924), the sugar content was moderately low in 2 runners and markedly decreased in 4. There was a close correlation between the physical condition of the runners at the finish of the race and the level of the blood-sugar. In the third series (1925), runners who had hypoglycemia or manifested hypoglycemic-like phenomena were placed on a high carbohydrate diet and administered dextrose in the form of candy during the race. The blood studies in all runners showed normal sugar levels and improved general condition in contrast with the low figures and physical exhaustion previously noted.

Nine runners of the group first observed in 1923 have been examined between races during the past six years. So far as determined, no important changes have occurred other than increased lung markings and the usual evidence of advancing years comparable with those noted in most athletes accustomed to less strenuous forms of exercise.

The opportunity to study a large group of long-distance runners in daily competition occurred in March, April and May, 1928, during a transcontinental foot-race from Los Angeles to New York City. Since the course of the race extended through Oklahoma, Arizona, New Mexico, Missouri, Ohio, Illinois, Pennsylvania and New York, a wide variation in altitude, climate and road conditions was inevitable. It appeared at the beginning of the race that, however efficiently the contest was managed, there would be unusual difficulties in providing suitable clothing, food and shelter and in preventing or treating injuries and infections. Apart from the

interest in determining the immediate untoward effects of strenuous prolonged effort and the adaptability of the body to an unusual and rapidly changing environment, it seemed that the data acquired would be of value in follow-up studies in later years.

THE PLAN OF STUDY. A detailed history of past infections and various experiences in athletic training and competition was obtained in 90 competitors before the start of the race. A physical examination, including a study of the urine, vital capacity and blood-pressure was also made. One of us (J. C. B.) accompanied the runners during the entire race and recorded at frequent intervals changes in the physical signs and general appearance of the athletes. The causes for withdrawing from the race and the effects of weather, altitude, road conditions, epidemic infections, types of food consumed, dietary habits and hours of sleep, the mental attitude of the runners and the ability to cope with various problems particularly in the face of injury were noted.

OBSERVATIONS BEFORE THE RACE. In the race 199 competitors were entered from almost every country in the world and 29 states in America. The oldest runner was aged sixty-four years, and the youngest was seventeen years. In the entire group not over 40 competitors appeared capable of withstanding strenuous athletic competition: 6 runners were found to be suffering from acute respiratory infections, 9 had gastrointestinal symptoms, 1 had signs of active pleurisy, 4 had chronic bronchitis, 11 had moderate emphysema, 1 had a morning temperature of 102° F., and 18 had more or less serious contusions of the feet, legs or knees; oral sepsis was common; approximately 50 per cent of all competitors were underdeveloped physically and could scarcely be compared with long-distance runners usually seen in universities or athletic clubs. It was found that only 6 runners, in preparation for the race, ran over twenty-five miles daily, and comparatively few had competed in important long-distance races. There was an extremely wide difference of opinion as to the most effective style of running. The advisability of massage, treatment of injuries and the most desirable foods were questions in which there was no general agreement. The vital-capacity estimations, according to accepted standards,[5] were found to be within normal limits except in 8 runners, who showed an average increase of 15 per cent, and 7 who had a decrease of 5 per cent. The blood-pressure readings were essentially normal, but the heart-rates were usually low (50 to 65). Systolic murmurs at

the apex were noted in 12 runners. In the examination of the urine there were 17 instances of albumin, 3 specimens showing hyaline casts and white blood cells.

Observations During the Race. The first three weeks of the race were characterized by almost every violation of the accepted principles of diet and hygiene, and disregard for physical injuries, infections and human endurance. Numerous fads and fancies were evident in the selection of food and in the time and manner of eating. Raw, dry and thoroughly cooked foods were used; certain runners followed strictly vegetarian diets while others consumed liberal portions of meat. Some competitors were opposed to drinking water and eating between meals; others favored the intake of carbohydrate while running.

The general appearance of most runners after completion of the daily milage was that of exhaustion, with cold perspiration, dyspnea, drawn facial expressions, hunger, thirst and a desire to sleep. Tonsillitis, diarrhea, shin splints,* injuries to the feet, pains in the abdomen, blisters due to sun and wind, albumin, granular casts, red and white blood cells in the urine, transient extrasystoles and increased heart-rate were among some of the manifestations noted. The extent and rapidity of recuperation depended largely on the amount of sleep, the quantity and quality of food, the disappearance of infection and physical injuries. It was noteworthy that few participants regarded infection or injuries with great concern, whereas officials advised runners repeatedly to seek medical care and to retire from the race. It appeared that the chief cause for withdrawal was the occurrence of pain and stiffness in the limbs, which increased the running time and thus rendered remote the chances for finishing within the first third.

As the race progressed, other complications in addition to those previously noted were as follows: boils (one rectal abscess), diarrhea, tympanitis, sudden elevation in temperature while running, nausea, acute upper respiratory infections with fever of 100° to 101° F.,

*"Shin splints" result from myositis and accompanying periostitis, the extensor muscles of the lower lateral aspect of the legs being chiefly involved. The condition is characterized by redness, swelling, pain and tenderness. The symptoms usually subside in eight to nine days, but not infrequently stiffness, "knotting" and shortening of the muscles occur. Fibrous tissue is often palpable. Ideal treatment consists of rest and application of heat; massage is contraindicated. Obviously, judicious treatment could not be carried out if the runners were actively engaged in the contest. It was interesting to note that "shin splints" did not occur in the English runners, who ran in a more or less flat-footed manner, lifting the feet not more than 3 to 4 inches from the ground.

loss of toe nails, blisters of the feet and injuries from passing automobiles. The physical discomfort was aggravated often by high winds, sudden changes in altitude and temperature, dusty, alkali or muddy roads. It was impossible after the first four weeks to provide the runners with desired types of food. One runner continued to eat raw food, several maintained strict vegetarian diets, but the majority consumed without restriction. A change which was almost general was the consumption of oranges, lemons, dates, dextrose and chocolate or some form of readily available carbohydrate between meals, while running. Several competitors used tobacco and in addition to eating between meals, took coffee with generous helpings of sugar at the end of the daily lap. Although an average of two or three competitors retired weekly throughout the race, with few exceptions the causes were financial, loss of interest or injuries to the feet. So far as determined, there were only 7 instances of exhaustion and these appeared to result from the lack of training and physical incapacity evident before the start of the race. The race lasted for eighty-four days, the daily average milage was 44.2, the total distance was 3484 miles, the greatest daily distance covered was 72 miles. When the race was ended in New York City, 14 runners (57 completed the race) showed evidence of fatigue, lameness and loss of weight. The remaining athletes appeared in excellent health and ran the last 25 miles in less than two hours and fifty minutes. It was striking to note that 9 runners were as free from dyspnea, fatigue and perspiration as would be expected from athletes after a series of moderate calisthenic exercises.

Observations After the Race. Three days after the finish of the race, 25 runners, who had covered the entire distance, and 2 participants who walked or ran approximately 2000 miles, were brought to the Chest Department of the Jefferson Hospital for a general physical examination. The observations, made possible through the coöperation of members of the staff of the Jefferson Medical College and Hospital, included microscopic and chemical studies of the blood and urine, roentgenographic, electrocardiographic, opthalmoscopic, orthopedic and laryngeal examinations.

The data noted in the general physical examinations are as follows: Pulsation of veins of the neck, 1; emphysematous type of chest, 5; abdominal-type breathing (predominating), 7; delayed respiratory expansion on one side of the chest, 2; distant breath sounds throughout, 9; pleural friction rub at right base (history of

pleurisy nine years previous), 1; pleural friction rub at left base (noted in the beginning of the race),1; râles at the apex with impaired percussion note (history of infection suggesting pulmonary tuberculosis at twelve years), 1; forceful apex beat, 2; systolic murmur at apex, 9; extra-systoles, 1. Pulse-rates varied between 50 and 80. Blood-pressure varied between 105 and 150 systolic; 55 and 85 diastolic.

The opthalmological examination showed the fundus redder than normal in 12 runners; the disk margin hazy in 4; the vessels slightly fuller than normal in 5 runners.

The orthopedic examination showed 5 instances of palpable edema along the anterior tibial margins; considerable callus on the plantar surface of the feet in 6 runners; tenderness and swelling of the tendon of Achilles in 2 and tenderness of the soft portions of the anterior tendons of the feet in 3 runners. Shoes which were ill-fitting were used by 18 runners.

The surgical examination showed the presence of varicoceles in 4 runners (one had been present for twenty-one years); and 1 hernia, which was noted before the race.

The laryngeal examinations showed varying degrees of caseous hypertrophic and cryptic tonsillitis in 17 runners; inflammation of the nasal mucosa with discharge was noted in 13 instances.

In the examination of the urine a series of specific-gravity tests varied between 1010 and 1028; no casts or red blood cells were found. The specimens were free from albumin and acetone, and, according to the Benedict qualitative method, no sugar was noted.

In the examination of the blood the red blood cells varied between 5,000,000 and 5,800,000; the white blood cells between 4700 and 6000; the hemoglobin (Dare-candle) varied between 90 to 98 per cent.

The highest reading for nonprotein estimation was 41.5, and the lowest 35.5 mg. per 100 cc. of blood; the highest blood-sugar was 0.101, and the lowest was 0.092 mg. per 100 cc. of blood.

In the roentgenographic study,[7] made to determine the effect of prolonged effort in the heart, lungs, bones and bloodvessels, the lungs were found to be essentially normal. The bones, except for osteoarthritic changes, were essentially normal except in the older runners. The bloodvessels in the older runners showed evidence of sclerosis. In 13 runners the hearts appeared to be definitely smaller

than normal; in 5 runners the hearts were within normal limits, and in 5 instances the hearts, according to the table of Bardeen, showed an increase in size. According to the so-called cardiothoracic ratio, only 1 heart was increased in size, and this occurred in the oldest runner. The data as a whole suggest that the effects of exercise are inconsequential, since all of the changes noted may be found in individuals of similar ages who have no symptomatic complaints.

In the electrocardiographic examinations there was a tendency to rather high take-off of the *T*, and a large excursion of the *P* waves in 4 runners and extrasystoles in 1 instance.

It was interesting to note that runners who had shown lameness and fatigue at the finish of the race were considerably improved, and that 5 runners had gained 3 pounds in weight.

Since completion of these examinations correspondence has been carried on with the group observed in Philadelphia and 34 additional athletes, in order to determine the course of events following the return to normal life. Some of the answers to the questionnaire were as follows:

"I am in good health, in fact I never felt better in my life. . ." "After returning to my home I climbed a mountain 11,824 feet high and experienced no difficulty. . . ." "My legs, which were sore, are all right now, and I am able to run. . . . " "Feel fine and fit. . . ." "My weight increased from 140 to 166 pounds and I became tired; then I started to train and now feel fine and will enter races in the future. . . ." "My doctor says I am just as sound as ever. . . ." "I am running every morning at least 40 miles, and the Sunday before Christmas I ran 72 miles and finished in excellent shape. . . ." "There is not one thing wrong with me."

Comment. It appears that certain individuals accustomed to leading sedentary lives and others affected with degenerative changes are in danger of catastrophe during the performance of strenuous exercise. The question, however, that restriction of physical effort in the comparatively normal, active individual may be unnecessary and perhaps actually harmful, is unsettled. The unique performance of 52 adult individuals running an average of 42 miles for eighty-four consecutive days, in an environment comparable only with frontier life of seventy-five years ago, suggests that factors other than work should be considered in appraising the capacity of

endurance of the human body. A solution of the causes for fatalities in athletes may be found in differentiating between "heart strain," nervous influences and metabolic disturbances under brief strenuous competition and the effects of prolonged daily running. Obviously the data presented in the report must be considered critically because some of the observations were made under circumstances not conducive to thorough investigation. The investigation is reported primarily to suggest that the human body during exercise may acquire extraordinary capacity for work and resistance to infection.

Conclusions. 1. A study of 199 participants in a transcontinental foot-race was made to determine the qualifications for successful competition and the effects of prolonged daily exertion.

2. A marked difference was noted in the age, nationality, physical development, experience in running and habits of food consumption.

3. The race was characterized by almost every violation of the accepted principles of diet, hygiene and disregard for injuries, infections and human endurance.

4. The chief causes for withdrawal were so-called "shin splints," financial difficulties and lack of interest in the content. So far as determined there were only 7 instances of exhaustion and these appeared to result from lack of training and physical incapacity evident before the start of the race.

5. It appeared that a high-caloric intake, derived from all foods, was more important than any fixed dietetic regimen. The most successful runners consumed readily available carbohydrate between meals, followed an unrestricted high-caloric diet at mealtime and ingested meat at the evening meal.

6. The details of a complete physical examination, made three days after the finish of the race, are tabulated.

7. The data suggest that the comparatively normal human body, provided with adequate food and rest, may acquire during prolonged exercise unusual capacity for work without apparent untoward effect.

Note.—We are indebted to Drs. Ross V. Patterson, J. Torrance Rugh, John B. Flick, Robert M. Lukens, J. Scott Fritch, C. W. Nissler, M. S. Jacobs, M. J. Sokoloff, John T. Farrell, Jr., P. C. Langan, J. Villegas A., James Surver, Misses Mary Cushen, Katherine Shaeffer, Sara Morton, Katherine Louser, Ena Hellenbroich, Mr. Richard Coombs, and the runners; without their kindly coöperation this study would have been impossible.

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DISCUSSION

Dr. David Riesman: Dr. Gordon's study is very interesting and suggestive. It seems that the runners when more or less exhausted were able to continue after eating sugar. For some time I have been using sugar in the treatment of cardiovascular disease, and have come to believe that sugar, chocolate, candy and carbohydrates in general are of distinct value in myocardial failure. Dr. Gordon's observations are circumstantial evidence in favor of that view.

Dr. E. B. Krumbhaar: I would like to ask, both, whether runners eating carbohydrates made faster time than those who did not, and, also, whether any deductions could be made as to carbohydrate ingestion increasing the muscular efficiency of the individual?

Dr. Gordon (closing): In regard to Dr. Krumbhaar's question as to whether or not all athletes experience hypoglycemia during prolonged exercise, the studies on DeMar, a famous long-distance runner, may be cited. This athlete has been observed in training, during and immediately after competition, and in every instance a normal blood sugar has been noted. He has never experienced hypoglycemic-like symptoms. His diet has never contained an excessive amount of carbohydrate. It has been suggested that certain individuals may acquire a mechanism in training which utilizes carbohydrate economically.

THE RELATIVE EFFICIENCY OF THE CLINICAL AND THE ROENTGENOLOGIC METHODS FOR SINUS DISEASE DIAGNOSIS*

With Observations on the Incidence of Sinus Disease: Based on the Findings in 200 Asthmatics and 50 So-called "Normals"

By RICHARD A. KERN, M.D.

and

HARRY P. SCHENCK, M.D.

In the course of routine examination of asthma patients for paranasal sinus disease, we were struck by the frequent discrepancies in the reports of findings by the rhinologist and the roentgenologist, discrepancies which were at times due to proven error on the part of one or the other of these examiners. It, therefore, occurred to us to subject a considerable series of asthmatics, first, to a clinical, then to a roentgenologic sinus examination, and finally to an operative investigation of the affected sinuses: we hoped in this way to learn something of the efficiency and the limitations of these two methods for the diagnosis of sinus disease. In order to estimate correctly the importance of the high incidence of sinus disease in bronchial asthma, it is necessary to take into consideration, among other things, the incidence of sinus disease in a control group of individuals—individuals not affected at the time of examination by obvious acute or chronic respiratory disease. A search of the literature failed to disclose any data on sinus-disease incidence in so-called "normals." We, therefore, examined clinically and by *x*-ray a control series of individuals selected in age-groups to correspond to the age distribution of the asthmatics. It is to some of the results of this work that we wish to call your attention this evening.

Two hundred patients with bronchial asthma, seen in the Asthma

* Read June 5, 1929.

Clinic and the wards of the University Hospital, formed the basis of this study. Ranging in age from four to eighty-one years, they were unselected except that individuals who had previously been subjected to sinus surgery were excluded. This was done because a sinus that had been operated upon will usually thereafter appear abnormal in the *x*-ray film. The clinical examinations were made by the members of the staff of the Department of Otolaryngology, and the *x*-ray examinations in the Roentgenologic Division of the University Hospital.

The clinical examination was made first in every instance. Previous experience had taught us that the clinical examiner might be unduly influenced by the *x*-ray report: with a previous knowledge of the *x*-ray findings he tended to agree with the roentgenologist far more frequently than was otherwise the case. The examiner was told, however, that his findings would be compared with those of a subsequent *x*-ray examination. If he failed to mention one or another sinus in his report, he was asked to reëxamine the patient. In the tabulation of our material, all "suspicious" reports were classified as positive findings.

While there is no time to dwell on the details of the technique of the clinical examination, we cannot refrain from emphasizing the importance of a careful clinical study, in which transillumination and the use of the nasopharyngoscope are indispensable.

In forming his opinion of the state of the sinuses the otolaryngologist has numerous difficulties to encounter. Transillumination is available for examining the frontal and maxillary sinuses. But light transmission may be altered by numerous anatomical variations: variations incident to age and sex; variations in thickness of bone and in size of the sinus; asymmetry, bony septa or the congenital absence of a sinus; and such altered light transmission may create an erroneous impression of frontal or maxillary sinus disease. For the rest, the examiner's information must be gathered from intranasal observation: this is often enough limited to septal deformity or the presence of large polypoid masses. The finding of pus in certain regions or of degenerative changes in the mucous membrane in these regions, especially as seen with the aid of the nasopharyngoscope, is, of course, most significant; but the overlapping of drainage areas of the different sinuses may again confuse the issue. Pus from both frontal and anterior ethmoidal cells is discharged into the middle meatus. Again, pus in the olfactory fissure may come from posterior

ethmoidal cells or the sphenoidal sinus, and direct infection of the sphenoidal ostium is possible in less than 30 per cent of cases. Finally, the absence of pus in a drainage area, on a single or even several examinations, does not rule out sinus disease.

While the *x*-ray examination was made after the clinical, the roentgenologist was not informed of the clinical findings. His report was, therefore, also an entirely independent and unaided one. The terminology used by the roentgenologist in framing his opinion reflects his attempt to interpret, as well describe, the changes found in the films—"thickened mucous membrane," "polyps in sinus," "hazy," etc. In our tabulation all abnormalities, irrespective of degree, were listed as positive.

The roentgenologist, also, is confronted by certain difficulties. He must consider variations incident to age and sex, asymmetry, bony septa, variations in bone thickness, the congenital absence of a sinus. Sinuses may be so situated that the shadows of adjacent groups will overlap. Permanent change in bone or mucosa may have resulted from previous sinus disease or from disease involving the sinus wall from without, as in the case of pathologic dental conditions involving the antrum. Acute disease may be too recent in origin to have produced roentgenographic change.

In order to get an absolute and complete check on the report of the two methods of examination, every sinus reported abnormal, clinically or by *x*-ray, should have been investigated by open operation. Unfortunately, we fell far short of this ideal, and for a number of reasons. Open operation on a frontal sinus is rarely performed except in case of acute empyema; in none of our patients did this occur. Again, it was impossible to get complete coöperation on the part of clinic patients. Many of them flatly refused any operation. Others, after one or two sinuses had been investigated, failed to return for any further operative procedure. Nor would the rhinologists go as far in some instances as we wished them to. They were quite willing to open a sinus that was obviously diseased clinically, but we failed at times to convince them of the desirability to investigate a sinus suspicious on *x*-ray but clinically negative. Nevertheless, in spite of all these shortcomings, sufficient data were obtained to be of some value in estimating the efficiency of these methods.

A summary of the clinical and *x*-ray findings in the 200 asthmatics is shown in Table I. These figures are in terms of number of

patients. Attention is called to high percentage (80.5) of asthmatics showing *x*-ray evidence of sinus abnormality. The clinical figures, while lower than those by *x*-ray, still reach an impressively high level—67 per cent. In fact, only 13.5 per cent of these patients had no evidence of sinus disease by either examination. But of particular importance is the complete disagreement between clinical and *x*-ray findings in 25 per cent of the patients. There were also enough instances of only "partial" agreement to increase materially the total number of discrepancies.

TABLE I

	Number of patients.	Percentage.
Total asthmatic patients	200	
X-ray examination positive	161	30.5
Clinical examination positive	134	67.0
Clinical and *x*-ray involvement (partial or complete agreement)	123	61.5
Both *x*-ray and clinical examinations completely negative	27	13.5
Complete disagreement	50	25.0
X-ray positive; clinical negative	40	20.0
X-ray negative; clinical positive	10	5.0

TABLE II.—INDIVIDUAL SINUS INVOLVEMENT AS REPORTED BY

	(A) *X*-ray examiner.		(B) Clinical examiner.	
	Number.	Per cent.	Number.	Per cent.
Right frontal	83	41.5	47	23.5
Left frontal	80	40.0	47	23.5
Right ethmoidal	110	55.0	67	33.5
Left ethmoidal	94	47.0	67	33.5
Right sphenoidal	37	18.5	21	10.5
Left sphenoidal	37	18.5	22	11.0
Right maxillary	113	56.5	92	46.0
Left maxillary	113	56.5	95	45.5

(These figures do not imply agreement between *x*-ray and clinical findings.)

In Table II are given the figures of positive findings for individual sinuses as reported by the roentgenologist and the clinician. This table bears no reference to the question of agreement between the clinical and *x*-ray reports. It will be noted that in both examinations positive findings were most frequent in the antra, next in the ethmoidal, then in the frontal, and least frequent in the sphenoidal sinuses. The number of clinical positives was less in every instance than the corresponding *x*-ray figure. It is interesting to note that, with the exception of the *x*-ray reports for the ethmoids, there was practically an equal incidence of positive findings for right and left by both methods of examination.

TABLE III.—COMPARISON OF *X*-RAY AND CLINICAL DATA BY INDIVIDUAL SINUS INVOLVEMENT

		Agreement.				Disagreement.			
		X-ray + Clin. +	*X*-ray 0 Clin. 0	Total number.	Per cent.	*X*-ray + Clin. 0	*X*-ray 0 Clin. +	Total cases.	Per cent.
Frontal	R	36	107	143	71.5	48	9	57	28.5
	L	32	107	139	69.5	47	14	61	30.5
	All	68	214	**282**	**70.5**	95	23	**118**	**29.5**
Ethmoid	R	53	77	130	65.0	55	15	70	35.0
	L	48	89	137	68.5	44	19	63	31.5
	All	101	166	**267**	**66.7**	99	34	**133**	**33.2**
Sphenoid	R	13	152	165	82.5	25	10	35	17.5
	L	14	152	166	83.0	24	10	34	17.0
	All	27	304	**331**	**82.7**	49	20	**69**	**17.2**
Maxillary	R	76	69	145	72.5	39	16	55	27.5
	L	76	71	147	73.5	35	18	53	26.5
	All	152	140	**292**	**73.0**	74	34	**108**	**27.0**

Turning now to the question of agreement or disagreement betwen clinical and *x*-ray reports for each sinus examined, we find the data summarized in Table III. Here the evidence of disagreement is most striking. Of 400 ethmoidal groups (200 right and 200 left) examined, the reports disagreed in 133 (33.2 per cent). The disagreements in the case of frontal and maxillary sinuses were almost as common. There were 4 instances of congenital absence of one frontal sinus as shown in the *x*-ray. Of these, 2 were called opaque clinically, while 2 were reported as normal on transillumination.

TABLE IV.—SUSPICIOUS CASES

Total patients with one or more suspicious sinuses by clinical or *x*-ray findings	173
Total patients coming to operation of one or more sinuses	86
Percentage of patients coming to operation	49.7

How far we fell short of a complete operative check may be seen in Table IV. Less than one-half of the patients submitted to any operative procedure and decidedly less than one-half of the suspected sinuses were investigated.

We come now to a discussion of the operative findings as indicated in Table V. The frontal sinuses may be rather briefly dismissed, for none came to operation. The reasons for this have been stated as (*a*) operative difficulties and (*b*) the absence of acute empyema in this series of patients. These reasons are, perhaps, not adequate on more searching analysis. The possible modes of investigation of

the frontal sinuses are: (1) Open operation (obviously not applicable in the overwhelming majority of cases). (2) Irrigation through a cannula introduced into the frontonasal duct. The finding of pus in the washings is, of course, indicative of disease, but the failure to obtain pus by no means rules out disease. (3) Lipiodol may be introduced into the sinuses by the expedient of partially exhausting the sinus-contained air by suction and then allowing lipiodol to be sucked into the sinus from the nose. An *x*-ray film may then be taken. Unfortunately, we were unable to examine any of our frontal cases in this way. This is to be regretted, for the lack of agreement between the clinical and *x*-ray reports was particularly great in the frontals—29.5 per cent.

TABLE V.—TABLE OF PERCENTAGE OF ERROR OF *X*-RAY AND CLINICAL METHODS OF SINUS EXAMINATION, BASED ON OPERATIVE FINDINGS

	Total cases.	*X*-ray correct.	*X*-ray wrong.	*X*-ray error, per cent.	Clinical correct.	Clinical wrong.	Clinical error, per cent.
Ethmoid .	70	60	10{8 Diseased 2 Normal	= 11.4 = 2.9 14.5	53	17 (All diseased)	= 24.3
Sphenoid .	20	18	2 (2 Diseased)	= 10.0	14	6{5 Diseased 1 Normal	= 25.0 = 5.0 30.0
Maxillary .	110	57	53{ 3 Diseased) 50 Normal	= 2.6 = 45.6 48.2	62	48{10 Diseased 38 Normal	= 9.1 = 34.5 43.6

Coming now to the ethmoidal sinuses, it is to be stated, in the first place, that the operative determination of the "diseased" or the "normal" state of the sinus rests on fairly good evidence—the actual finding of pus, grossly abnormal secretion or the presence of polyps. The criticism that might be offered is that smears were not routinely examined for pus and bacteria. The *x*-ray error in this group was decidedly less than the clinical—14.3 per cent against 24.3 per cent. The roentgenologist failed to recognize 8 of 68 diseased ethmoidal groups; 4 of these 8 were apparently cases of acute infection and perhaps of recent standing; in 3 instances polyps in the ethmoidal cells were overlooked by the roentgenologist. This was, however, not a constant error, for the reverse occurred in 1 patient, in whom the right ethmoidal group, positive on *x*-ray but negative clinically, was found to contain polyps at operation. On

the other hand, the x-ray reported as pathologic two ethmoidal groups which were found normal at operation. In one of these the history suggested that the x-ray findings were the result of permanent change in the sinus wall or mucosa, due to preëxisting but no longer active disease.

In addition to these absolute errors by the roentgenologist, reference must be made to errors in some of his attempts to interpret as well as describe abnormalities seen in the films. In 4 instances he reported the change as due to "thickened mucous membrane," a report which might not be considered as evidence of active disease and might, therefore, deter the surgeon from intervening; yet in all 4 instances frank pus was found at operation.

The clinical error in the ethmoidal group lay wholly in the matter of overlooking active sinus disease, an error that was demonstrable 17 times. All 17 had given positive x-ray findings. In some of these there was frank pus in the sinuses, but no secretion was present within the nose at the original examination. The importance of making repeated clinical examinations in such cases before giving a negative report is obvious. No normal ethmoidal sinuses were wrongly called diseased. The x-ray examination of the ethmoidal sinuses is obviously much more accurate than the clinical.

The operative proof of sphenoidal disease, as in the case of the ethmoids, was based on good evidence—the finding of polyps, pus or grossly abnormal secretions. The x-ray missed only 2 of 20 diseased sphenoids, an error of 10 per cent. In 1 of these the error may be explained by the fact that the film was misinterpreted, in that a shadow in the sphenoethmoidal region was attributed only to the ethmoidal cells and not also to an overlapping sphenoidal sinus. The other case was the only instance in which both the clinical and the x-ray examination failed to find a diseased sphenoidal sinus: after a right middle turbinectomy the nasopharyngoscope showed pus coming from the sphenoidal ostium and the sinus when opened was found to contain pus.

The clinical examination was wrong in 6 instances, an error of 30 per cent. Five times chronic disease was overlooked; in 4 of these the x-ray had been positive. In one instance a normal sphenoidal sinus was called "diseased," through wrongly attributing pus of ethmoidal origin to both sphenoidal and ethmoidal cells. Again, the x-ray examination gave on the whole more accurate results.

Coming now to the maxillary sinuses, the alleged percentages of

error are amazing. The roentgenologist, while overlooking only 3 diseased antra, is said to have reported 50 normal antra as being pathologic, an error of 45.6 per cent. Nor did the clinical examiner seem to do much better: he overlooked 10 diseased sinuses (9.1 per cent), but is alleged to have called 38 normal sinuses diseased, an error of 34.5 per cent.

These figures, we are sure, are incorrect. The error arose from the fact that in 31 instances the clinician based his opinion "normal sinus" on the fact that he obtained no evidence of disease on irrigation of the antrum. This is absolutely fallacious. It is a well-known fact that antrum washings will be returned clear in case of antral polyps, thickened diseased mucosa or in the presence of inspissated secretion. In one of our patients both antra were reported diseased by *x*-ray and were opaque to transillumination. Both sinuses were irrigated with negative results. We insisted that the antra be openly explored; this was done and both sinuses found filled with polyps. Yet in spite of this and similar instances we were often unable to convince the rhinologist of the necessity of opening all suspicious antra. Had this been done the alleged percentage of error of both examinations, especially of the *x*-ray, would have been materially reduced.

However, a sufficient number of antra were adequately studied to give convincing evidence that there is a distinct *x*-ray as well as a clinical error. The *x*-ray error may be due to overlooking active early acute infection; these are usually recognized by the clinician. Much more significant are those cases in which a positive *x*-ray finding was not corroborated on open operation. In some instances the *x*-ray reported "thickened mucous membrane," clinical examination negative; at operation no abnormality was found and inspection of the interior of the sinus by the antroscope showed normal mucosa. In others the *x*-ray report was "cloudy" and the sinus clinically did not transmit light normally, yet at open operation no abnormality was found. Some of these patients gave long histories of sinus disease and had active disease in other sinuses at the time the antra were found normal. It is quite probable that these antra had been the site of infection at some previous time, an infection which produced a permanent change in the sinus, probably with bony alteration from periosteal involvement; permanent change which gave and always will give an abnormal *x*-ray film, and in the more marked instances abnormal transillumination findings as well.

A further relative x-ray error was quite common in the antrum reports. In the case of the antra the roentgenologist most often attempted to interpret his findings in terms of pathologic process; *e. g.*, "thickened mucous membrane" or "polyps," and at times these diagnoses were correct. They were, however, incorrect in sufficient numbers to make it hazardous to give them routine credence, especially if, in the absence of clinical findings, one is tempted to consider a "thickened mucous membrane" report as probably indicative of a sinus not actually diseased. Again, 6 antra called "cloudy" on x-ray examination were later studied by lipiodol injection (injections being made by Dr. Houser), and at a second x-ray only thickened mucosa was found. In 4 of the 6 this was confirmed at operation.

There was also a very definite clinical error, and distinctly greater than that of the x-ray. The chief pitfall for the unwary clinician seemed to be in the interpretation of transillumination findings. Four antra, x-ray positive but clinically negative, were found full of pus at operation. Four antra filled with polyps gave normal transillumination findings. In another case, inspissated secretion gave x-ray clouding, but transmitted light normally on two examinations and the rhinologist insisted that the x-ray findings must be due to thickened mucous membrane and at first refused to open the sinus. He later did open it and was surprised to find it filled with a gelatinous mass of secretion that could be pulled out of the sinus in a single lump. Thickened mucous membrane or periosteal change, the result of former disease, may permanently alter transillumination findings and give an erroneous impression active disease. This, however, is less frequently the case than with the x-ray. Finally, variations in bone thickness may cause confusion: in one patient, whose antra were negative to x-ray, but transmitted light poorly, operation showed thick-walled but normal sinuses.

These observations justified the suspicion that in sinus examinations, especially by the x-ray, the evidence of past disease as well as present was being picked up. Moreover, our figures of incidence of sinus disease in bronchial asthma, while actually very high, had no absolute value unless they could be compared with figures from a series of nonasthmatics. A search of the literature failed to disclose any data on sinus-disease incidence.

We, therefore, studied 50 patients in the medical wards of the hospital. Those were selected who gave (*a*) no history of recent respiratory disease, (*b*) no history of susceptibility to colds, (*c*) no

history of frank sinus disease in the past, and (*d*) whose ages fell proportionately in the same decades as those of the 200 asthmatics. A group so selected may well be considered as better than any average group of 50 individuals.

TABLE VI

	"Normals."		Asthmatics.	
	Number of patients.	Per cent.	Number of patients.	Per cent.
Total individuals examined	50	....	200	
X-ray examination positive	36	72.0	161	80.5
Clinical examination positive	13	26.0	134	67.0
Clinical and *x*-ray involvement (partial and complete agreement	10	20.0	123	61.5
Both *x*-ray and clinical examinations completely negative	11	22.0	27	13.5
Complete disagreement:)				
X-ray positive; clinical negative . . .	24	48.0	40	20.0
X-ray negative; clinical positive . . .	3	6.0	10 ·	5.0

A summary of the clinical and *x*-ray findings is given in Table VI, with the figures for the asthmatics for comparison. The findings are rather surprising. The incidence of *x*-ray evidence of sinus disease is almost as high in the control group as in asthmatics. On the other hand, the clinical evidence of sinus disease is much lower. There is consequently a high percentage of disagreement, composed almost entirely of *x*-ray positive, clinically negative patients.

None of these 50 patients had symptoms referable to sinus disease, yet only 11 of the 50 were negative by both examinations. It was, of course, out of the question to subject these patients to operative investigation of the suspected sinuses, so that we have no final check on the accuracy of these findings. It would seem reasonable to suppose, however, that in many, perhaps most, instances the positive findings were due to sinus disease in the past, not active in the present. In other words, sinus disease tends to produce in most cases permanent changes that will thereafter be evident in the *x*-ray film and not infrequently on transillumination.

It is also obvious that sinus disease is a very common condition that at one time or another affects the majority of the population in this vicinity.

TABLE VII.—AVERAGE NUMBER OF SINUS GROUPS INVOLVED PER PATIENT IN THOSE SHOWING SINUS DISEASE

By *x*-ray	I. Asthmatics	4.14
	II. "Normals"	3.98
By clinical	I. Asthmatics	3.42
	II. "Normals"	2.34

We next compared the number of sinuses involved per patient in the asthmatics and in the control group. If a sinus or sinus group be counted as 1, and if a patient had both antra, both frontal, both ethmoidal and both sphenoidal groups involved—*i. e.*, a pansinusitis—his sinus involvement figure would be 8. If he had only the right ethmoidal group or one frontal sinus affected, the figure would be 1. It will be seen in Table VII that the degree of involvement as determined by *x*-ray was practically the same in the controls and in the asthmatics. The clinical findings, however, showed a distinctly lower degree of involvement in the control group.

One other point deserves mention: a tabulation of sinus involvement in patients according to age by decades would seem to show that the age of the individual has no particular influence on the incidence of positive *x*-ray or clinical findings in either asthmatics or controls.

CONCLUSIONS. The following conclusions seem justified:

1. Neither the *x*-ray nor the clinical examination of the sinuses is 100 per cent accurate.

2. Of the two, the *x*-ray is the more sensitive, especially in the study of the ethmoidal and the sphenoidal sinuses.

3. The *x*-ray examination will pick up the evidences of sinus disease past as well as present: a positive *x*-ray finding, therefore, does not imply clinically active disease.

4. The attempt to interpret *x*-ray findings in terms of pathologic change (thickened mucous membrane, polyps) may be misleading, since the alleged diagnosis is not infrequently wrong.

5. The *x*-ray examination will often overlook acute recent sinus infection.

6. The clinical examination alone is able to give positive proof of active sinus disease.

7. The clinical examination frequently overlooks chronic disease, especially of the ethmoidal and sphenoidal groups, if there is no abnormal secretion in the corresponding drainage areas and the mucous membrane as seen by the nasopharyngoscope shows little if any change.

8. It is, therefore, desirable that patients with suspected chronic sinus disease be reëxamined several times before a negative clinical opinion is given.

9. The clinical examination will find at times the evidence of past sinus disease, although not as frequently as the *x*-ray.

10. Transillumination findings may be fallacious; polyps or mucoid secretion may transmit light normally; pathologic change due to former disease or a normally thick bone may be wrongly interpreted in terms of active disease.

11. Neither method is, therefore, to be relied upon alone; both must be used routinely in the study of patients with suspected sinus disease.

12. Sinus disease is extremely prevalent in persons of all ages in this vicinity.

13. Age is apparently not a material factor in the incidence of sinus disease.

DISCUSSION

Dr. Clarke: This is a very interesting paper and I do not know that anything can be added to it. All of us who have done work with sinuses realize the extreme difficulty of diagnosis. Equally good rhinologists will give conflicting reports. Even on the *x*-ray plates, the interpretation depends on the individual who reads them. These patients have to be examined frequently, particularly with transillumination, because the findings change from time to time. In the first part of the paper, I do not recall whether the maxillary antrum was transilluminated with the light inside or outside the mouth. It should be done by both methods. An antrum may be opaque with the light outside and yet transmit light fairly well when the light is placed in the mouth, and *vice versa*.

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LEUKOCYTOSIS IN MALIGNANT DISEASE*

The Report of an Unusual Case

By DAVID RIESMAN, M.D., Sc.D.

AND

DAVID A. COOPER, M.D. (By Invitation)

Studies of the blood in malignant disease stress the anemia, but make only a scant mention of leukocytosis, though that is not infrequently present.

Andral,[1] it seems, was the first, in 1823, to call attention to an increase of white cells in the blood of a person who had died of cancer. In 1867, Lucke and Virchow[2] found leukocytosis in patients with malignant disease. Virchow attributed this to an increased flow of lymph, the increased number of white blood cells being in his opinion derived from the tumor itself. Palmer, in 1896, described a case showing multiple glandular swelling with a normal blood picture, later changing to one of leukemia. At necropsy a primary round-cell sarcoma of the thymus with metastasis in various organs and bilateral suppurative nephritis were found.

In 1896, Martin Matthewson and Alexander[3] reported several cases of sarcomatosis with marked leukocytosis, in which the predominating cells were of the lymphocytic or mononuclear type.

The studies of Grüner, in 1916,[4] on the change in the leukocytic picture in malignant disease are of unusual interest. He concludes that if there is neutrophilia with bizarre forms, if many of the lymphocytes show ameboid outlines, if the monocytes show ameboid nuclei, the case is almost certainly one of malignant disease. Comparatively recent reports, by Dieballa and Entz,[6] Bizarri[5] and Piney,[7] record cases similar to our own. According to Piney there were prior to his report of a single case, only 2 similar ones on record, namely, those reported by Dieballa and Entz and by Bizarri.

* Read June 5, 1929.

In our case the blood picture was so unusual that it is deemed worthy of being reported.

H. S., a married man, aged sixty-nine years, has had asthma for thirty years. About eighteen months before coming under observation he had hemoptysis but without visible impairment in health until the past few months, when he began to have burning pain between the shoulders, worse on lying down. Recently he has had difficulty in swallowing and a girdle sensation around his lower chest. There was nothing of importance in the previous history or in the family history.

Physical Examinations. The patient is a well-developed man of about seventy years. The pupils are equal and react promptly. There is no sinus or mastoid tenderness. The tongue is coated, the teeth are in poor condition. There are no glandular enlargements in the neck. The chest is of emphysematous type. The heart is slightly enlarged on percussion; percussion also shows a definite increase in the supracardiac dulness. The heart sounds are weak, but there is no arrhythmia, no murmur. The right lung shows a few rhonchi at the base. In the left lung the percussion note is impaired between the vertebral border of the scapula and the spine; vocal resonance is diminished in this area and the breath sounds are harsh; a few râles are heard over the left base. The abdomen reveals nothing abnormal.

Extremities. There is slight edema of the ankles, the knee-jerks are normal. There is no tenderness over the long bones or sternum.

The temperature during hospitalization varied from 98° to 100°, the pulse from 90 to 100 and the respiration from 24 to 30.

The urine was negative on repeated examinations.

The Wassermann test was negative.

A roentgenogram of the chest showed the heart and lungs to be negative, but there was a dense shadow in the posterior mediastinum that suggested an aneurysm of the descending arch of the aorta or a tumor.

Roentgenographic studies of the long bones revealed no metastasis; the left pubis, however, was suspicious.

The examination of the blood showed: Red blood corpuscles, 4,000,000; white blood corpuscles, 56,300; hemoglobin, 78 per cent; neutrophiles, 95 per cent; lymphocytes, 3 per cent; mononuclears, 1 per cent; myelocytes, 1 per cent. Many of the neutrophiles were young forms. The leukocytes varied from 40,000 to 60,000 on repeated examinations during the four weeks of observation.

The two following counts are typical: hemoglobin, 80 per cent; white blood corpuscles, 64,800; neutrophiles, 91 per cent; lymphocytes, 4 per cent; mononuclears, 2 per cent; basophiles, 1 per cent; myelocytes, 2 per cent.

White blood corpuscles, 59,600; neutrophiles, 92 per cent; lymphocytes, 3 per cent; metamyelocytes, 3 per cent; myelocytes, 2 per cent.

A diagnosis of mediastinal tumor was made and roentgen-ray therapy instituted. The patient showed no improvement and was allowed to return to his home, where he died soon afterward. A necropsy was per-

formed and a large mediastinal growth was found that on section proved to be a sarcoma of large spindle-cell type. Unfortunately, at the autopsy specimens were not taken from the bone-marrow.

The possible explanations for a leukocytosis in malignant disease are:

1. Associated infection.
2. Metastasis to bone-marrow.
3. Hemorrhage.
4. Absorption of toxic products from the growth.

1. Secondary infection in malignant growths situated on a surface is an ever-present possibility. Such is the case in bronchial carcinoma when the tumor causes obstruction and the development of pneumonitis distal to the site of the lesion. Infection is also prone to occur in renal carcinoma with ureteral blockage, and, of course, it is a common occurrence in malignant tumors of the gastrointestinal tract.

2. Bone-marrow Metastasis: The work of Piney[7,8] has placed this mechanism for the explanation of leukocytosis on a firm basis. The profound changes in the blood picture in some cases of malignant disease are best explained by assuming an injury to the bone-marrow. Piney believes the metastasis to be by way of the blood stream rather than by way of the lymphatics.

Any kind of malignant growth may give metastasis to the bone-marrow. Sarcomas are more prone to give this type of metastasis. Osseous metastasis causes marked changes in hemopoesis. These changes fall into two main groups, the more common type which simulates pernicious anemia, described by Ehrlich in 1878,[9] and the rarer form in which a leukemoid blood picture is found. There is apparently no relationship between the site of the primary tumor and the character of the blood picture.

3. Hemorrhage, which may be sudden or gradual, stimulates the bone-marrow to increased activity, with the production of white blood cells as well as red cells; this probably accounts for the moderate leukocytosis that is seen relatively frequently in malignant disease. Hemorrhage into the tumor itself is often an added stimulus for the production of a leukocytosis.

4. The absorption of toxic products from the growth itself might conceivably act in a chemotactic way upon the leukocytes. Ewing[11] states that "the uncomplicated tumor process seems to have no

capacity to attract leukocytes to the circulation." Too little is known about the production of toxic substances in tumors to justify any definite conclusions. A moderate leukocytosis might be due to the secondary anemia so often found in malignant disease and could be attributed to a stimulation of the bone-marrow.

Discussion. We have presented a case of spindle-cell sarcoma, arising in the mediastinum, with marked leukocytosis. A reasonable explanation of the blood picture is metastasis in the bone-marrow, even though there was no roentgenologic evidence of such metastasis. In the consideration of this point of metastasis to bones, we should like to refer to two other cases that we have observed.

H. R., a man, aged fifty-five years, had carcinoma of the stomach with marked roentgenologic evidence of metastasis to the spine and pelvis; yet his blood picture during a year's observation, almost up to the time of his death, was only that of a mild secondary anemia.

The second case, Mrs. K. W., aged sixty-six years, had been anemic for years. Her case, after careful study, had been diagnosed as typical pernicious anemia. She improved under liver therapy and did not return for a year. On readmission she was found to have an inoperable carcinoma of the stomach. There was no clinical evidence of bone metastasis, but at autopsy, which revealed a large cancerous growth of the stomach, the bone-marrow was found hyperplastic and on microscopic section showed metastasis.

Our patient with the marked leukocytosis showed no definite evidence of infection, although he had a moderate irregular fever and some sweating. Miller and Jones,[12] in a study of pulmonary growths, find fever without other evidence of infection a constant symptom. They believe that it is due to the growth *per se*.

The probability that hemorrhage was a factor in the production of the leukocytosis in our case is unlikely, as the anemia was of a mild degree. Fitz-Hugh,[12] in a study of the blood in gastrointestinal malignant disease, found no constant relationship between the degree of anemia and the number of leukocytes in the blood.

Absorption from the tumor as an exciting cause of the leukocytosis is a possibility, but since there was only a mild degree of anemia, it seems more logical to assume that the high leukocyte count—a leukemoid blood picture—was due to bone-marrow metastasis, even though roentgenologic evidence of such metastasis was lacking.

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DISCUSSION

Dr. George M. Dorrance: Leukocytosis in malignancy has never appeared to have had any diagnostic value in my cases. When I noted that Drs. Riesman and Cooper were going to read this paper, I looked up my last 150 cases, which represent all varieties of malignancy. In 20 cases I found the leukocytes to average 20,000, the remaining 130 cases showed the leukocytes to be about normal. Some of these cases had metastasis to the bone, and in these cases the proportion having leukocytosis was not greater than in the other cases. These 20 cases were advanced and were associated with anemia. Some of them had secondary infections. I realize my series is entirely too small to decide whether bone involvement causes leukocytosis. I particularly noted two breast cases with metastasis to the axillæ were among those showing leukocytosis. From my small series I am inclined to believe that the leukocytosis is entirely a secondary matter, and is of little or no value in diagnosis or prognosis of malignancy.

Dr. Thomas Fitzhugh, Jr.: In a study of gastrointestinal carcinoma, from viewpoint of anemia, Dr. Schell and I thought that the anemia was due largely to gradual blood loss. The cases showing anemia showed also definite microscopic loss of blood from gastrointestinal tract. Correlating anemia with leukocytosis led us nowhere. We felt that the mechanism which produced anemia was not the same as the mechanism which produced leukocytosis, at least in gastrointestinal carcinoma. Alvarez pointed out that the absorption of toxic products of infection in the growth might produce anemia. If such infection is also associated with leukocytosis, as one might think, then our study failed to confirm that mechanism of the anemia. We have no explanation for the leukocytosis that occurred in many of these cases. Bone-marrow metastasis often produces leukocytosis, but not always. For example, in many cases of carcinoma of the prostate with widespread bony changes, it is the exception to find leuko-

cytosis. As Dr. Riesman and Dr. Cooper pointed out, their report represents an exceptional case, and I am sure they did not mean to imply leukocytosis to malignancy in general. We have seen 2 cases this year in the University Hospital of this type (*i. e.*, the so-called "leukemoid blood reaction") one was a case of Hodgkin's disease, with about 60,000 leukocytes per c.mm., of which 90 per cent were eosinophils. Another, of mediastinal neoplasm similar to that reported by Dr. Cooper, had 45,000 leukocytes with 95 per cent neutrophils. The explanation of these unusual leukocytoses is still to be found.

Dr. Riesman: I would emphasize the point alluded to by Dr. Cooper, namely, that from a high leukocytosis in a chronic disease one cannot conclude that the case is one of infection; one should bear in mind the possibility of malignant disease. Secondary anemia, to which Dr. Cooper has incidentally referred, is at times a valuable index of the existence of a growth. Most often the tumor is located in the gastrointestinal tract; tumors of the stomach and proximal colon are especially prone to cause profound anemia, but those of the sigmoid may do likewise. Large tumors of the liver, strange to say, are often unattended by any marked anemia.

Dr. Cooper (closing): In this blood there was an occasional nucleated red blood cell reported.

ALTERATIONS IN THE VOLUME OF THE NORMAL SPLEEN AND THEIR SIGNIFICANCE*

The Mary Scott Newbold Lecture
Lecture XXI

By JOSEPH BARCROFT

FELLOW OF KING'S COLLEGE; PROFESSOR OF PHYSIOLOGY, CAMBRIDGE UNIVERSITY, CAMBRIDGE, ENGLAND

The work of three men whose names appear on the roll of this College, Pearce, Krumbhaar and Frazier,[1] has to me been so great a source of inspiration as to make this evening one which will always stand out in my memory. The pleasure of discussing the change of volume of the spleen in Philadelphia is as great as the sense of honor which I feel in being asked to do so by a society which numbers among its members some of those whose opinions on this subject are of outstanding authority. My own methods are perhaps different from most used by them and my only regret is that the occasion is that of a lecture rather than a medical exchange of experience.

Let me commence by stating very shortly, and so disposing of, certain inevitable methods of technique.

The object has been to form some estimate of the alterations in volume of this spleen when the animal is in full health and exercising his normal functions. Anesthetics must be barred and even the plethysmographic methods, so fruitful in the hands of Hargis and Mann,[2] and of Heymans,[3] have not been used because they postulate quiescence on the part of the animal. I have had recourse to two principal methods of investigation:

1. That of performing a preliminary operation in which small metal clips were placed along the edge of the spleen, and when the effects of the operation had entirely worn off, judging of the size of the organ by means of roentgen-ray photographs taken in the horizontal and vertical planes; from which photographs a presentable

* Read, October 2, 1929.

reconstruction can be made of the lineal outline (Barcroft[4] and others).

2. An operation by which the spleen, without injury to its vascular and nervous attachments, can be withdrawn through the body wall and fixed in a position outside of the skin. In this position the organ rapidly makes itself at home, so much so that it ultimately becomes covered by a delicate epithelium like that of the lip and is then proof against any but gross injury (Barcroft and Stevens[5]).

By either of these methods large alterations in the volume of the organ may be seen rapidly to take place. So large indeed are they as to convince the observer that the spleen may on occasion contain perhaps one-fifth of the whole blood volume.

The principal experimental procedures which will lead to the rapid disgorgement of this blood are asphyxia, carbon monoxide poisoning, exercise, hemorrhage and, as has been shown by Hargis and Mann,[2] and by Cannon and Izquierdo,[6] emotion.

I pass over these acute effects very briefly because they have already been described in print and I pass to certain effects which extend over longer periods of time, concerning which less has been already published. One comment, however, I must first make in the cases of hemorrhage and of exercise: the contraction of the spleen is not, as I had once supposed, a final effort on the part of the body to add to the blood volume. It is a very early effect, a kind of fine adjustment; like all fine adjustments, though useful, is not indispensable.

Prolonged Contraction of the Spleen. *The Effect of Pregnancy.*[7] The first experiment in which the spleen was exteriorized were, of course, somewhat of a speculation. These were carried out in the early summer of 1926. When the phenomenon of the contraction of the spleen on exercise had been fully established it became our intention to take one, at least, of the three animals in our possession to show at the Physiological Congress at Stockholm. The question was which should it be? We placed the dogs in an order of merit and the order remained undisturbed until a few days before the date of departure for the Congress. Then the spleen of our best animal suddenly became small and pale. The animal itself became extremely disinclined to take exercise, and when it did so the contraction of the already small spleen was not very well marked. We were, of course, greatly disappointed, partly because our best specimen had failed and partly because the possibility was introduced

that the exercise contraction of the spleen was a less constant phenomenon than we had supposed. However, two quite good specimens remained. These were taken to Stockholm, where the best, alas, was run over in the street by a motor bus. The remaining animal, however, proved quite a convincing demonstration of exercise contraction.

To return to the animal which we decided not to take. It was killed just before we started; our laboratory assistant, Sergt.-Major Secker, R.A.M.C., performed a postmortem upon it, and on our return from Stockholm we were greeted with the information that the uterus of the animal had contained fetuses in a fairly advanced stage of development. It must be confessed that we did not at once grasp the significance of what had taken place.

A second "accident," however, focussed our attention on the subject. We exteriorized the spleens of two dogs. Both spleens ran a somewhat similar course for a while, then one suddenly became much smaller and pale. It had shrunk in a few days to half its surface. Then one morning we came into the laboratory to find seven puppies. From this time the spleen gradually enlarged. Ultimately, partly because of the continued gradual shrinking of the spleen of the control animal and partly because of the gradual enlargement of the spleen of the recently pregnant one, the two became almost the same size.

From this time we undertook some systematic observations in the subject of the relation of pregnancy to spleen volume.

The technique at first was similar to that which has just been described. A bitch was "covered" by a dog: at the same time another of about the same size was chosen as a control. Four to five weeks afterward the spleens of the two were exteriorized. As the period of gestation in the bitch is sixty-three days, there remained about four weeks and a half in which the spleen could settle down. Usually it is not possible to make any comparisons which are of value for the first ten days. The size of the spleen depends upon the operative procedure for that period—a little more or less pressure on one of the splenic vessels will make a considerable difference. After that, about ten days, the comparisons between the "probably" pregnant and the control bitches were instituted. In each case there was little to choose in size between the spleens of the two animals at that stage, but in the last fortnight or ten days' pregnancy the spleen of the prospective mother shrank to an insig-

nificant size and became very pale, enlarging again after the birth of the pups and ultimately attaining the size of that of the control animal. Once the spleen had attained the same size they ran a pretty equal course, both gradually shrinking for a time. The least satisfactory feature of these experiments was that we were comparing the variations in the size of the spleen of the pregnant bitch not with a control whose size remained constant or practically constant, but with one which itself was gradually shrinking. At that time we had not discovered that after the spleen has been exteriorized for several months the volume changes relatively little. That discovery was made on an animal which had been used as a control in one of the above experiments. After her spleen had settled to a volume of relative constance it happened that she came on "heat." She took the dog successfully and so we had the opportunity of investigating the effect of pregnancy on a bitch whose spleen, apart from the demands of her reproductive organs, would have remained of relatively constant volume over a period of nine weeks.

The spleen showed a marked but passing contraction during the period of "heat." This was only a matter of a few days. It returned to its former size and no material alteration took place until nearly half way through the pregnancy. The spleen then commenced to shrink and reached its minimum size about four days before the birth of the pups. During those four days it altered but little, growing if anything, but directly after the pups were born the spleen rapidly became more turgid and within twenty days it was larger than at any time during the previous six months. Such is a rough outline of the facts. There are one or two points to be cleared up before we discuss their interpretation.

There is usually a certain amount of anemia associated with the exteriorization of the spleen. Could it be that the alleged pregnancy shrinkage was really a result of anemia, not in truth a primary result of the pregnancy? Hemoglobin determinations were made throughout the course of the experiment last quoted. The hemoglobin percentages were as follows:

Three months before pregnancy	Hb = 80.0
During heat	Hb = 74.6
During first half of pregnancy	Hb = 75.6
During second half of pregnancy	Hb = 70.2
During twenty days after	Hb = 72.2

The above results show that during the period of "heat," when the spleen was contracted, the hemoglobin values were not sensibly

lower than they had been previously. Throughout the whole of the pregnancy they remained in the vicinity of 70, with one or two exceptions, at which level they were at the time of birth and for some time subsequently. Moreover, the research of Shen[8] showed that, while bleeding caused a shrinking of the spleen, the fact of a low hemoglobin value did not necessarily do so.

Postoperative Contraction of the Spleen. During the course of experiments in which parts of the intestine were exteriorized,[9] some time after exteriorization of the spleen, some quite unexpected observations were made.

In the first two experiments of the series a loop of small intestine was withdrawn and placed outside the abdominal wall.[10] In both cases the animal seemed to do well even though the gut had not been severed and the food had to pass along the exteriorized portion. Neither dog, however, lived very long, the ultimate trouble in each case being perforation. In one animal the lesion was in the abdominal cavity. The dog suddenly became ill; the condition clearly being hopeless, it was killed. The postmortem examination showed a general infection of the abdomen.

The perforation in the other animal took place in the exteriorized portion; it was due to an accidental cause, namely, that the dog swallowed a piece of bone about 4 inches long. This was unable to get round an angle where the gut was fixed to the abdominal wall. In both these cases the spleen became quite small during the operation and did not regain the size thereafter. Indeed, in the first case, that in which general peritonitis developed, the spleen shrank even more than it had done; it was at its smallest when the animal died.

The question arose: Had these animals survived, would their spleens ever have attained to a size as great as that which they would have occupied if the subsequent abdominal operation had never been performed?

One experiment has taken place in which a portion of gut has been exteriorized with perfect success by Florey,[11] after the spleen had been exteriorized some two months previously. There was no indication of any general or even local infection. Nevertheless, the spleen again shrank to about half the previous size and remained so for about four weeks. After that time it dilated and attained the size which, judging from a control dog, it would have occupied if no intestinal operation had taken place. Here again we are in the dark as to whether the contraction was due to a nervous reflex or to some substance absorbed from the wound or elsewhere.

Significance of the Splenic Contraction. Having studied some of the phenomena, for their own sake, which the contraction of the spleen presents, we may now turn to the consideration of the question of what significance may be the splenic contraction. Let us go back to Gray's original thesis, that the function of the spleen is to control the quantity and quality of the blood.

The Regulation of the Quantity of Blood. Three factors appear to be connected, though the precise numerical relation between them is not as yet worked out.

1. The volume of blood in the body.
2. The volume of the bed in which it circulates, that is, the pressure under which the blood would be in the body if the whole circulation ceased.
3. The volume of blood which circulates per minute around this vascular system over short periods of time.

If, for instance, a certain quantity of blood is injected into the circulation, all observers (Daly,[12] H. Barcroft[13] and Jarisch[14]) agree that, other things being equal, the circulation rate will be increased.

They agree, moreover, that in the closed heart-lung preparation or in the intact but brainless animal the rate of increase expressed in cubic centimeters per minute is of the order of ten times the amount of blood injected. Thus, as will be seen from the following picture, roughly 20 cc. of blood injected will produce an increased flow of 200 cc. of blood per minute around the body.

Suppose then a dog to have a bloodflow of 1 liter of blood per minute around his body, and suppose that the spleen adds to that 100 cc. of blood. The increased bloodflow is found by multiplying the 100 cc. of added flow by 10, and is, therefore, 1 liter. The effect then has been to increase the ratio of bloodflow from 1 to 2 liters per minute.

In the case of exercise such an increase forms an appreciable proportion of the whole augmentation which takes place.

Moreover, the significance of the addition of blood from an outside source, such as the spleen, does not end with the statement which has just been made.

Among the various factors which conspire to give momentum to the blood when exercise is taken, is the augmentation of the depth of respiration.[15] Now if I understand aright, the effect of deepened respiration on bloodflow is not so much to add to the velocity of the circulating blood, but to multiply it by a factor.

Let me ask a question. If a certain degree of dyspnea increased the minute volume of blood from an initial value of 1 liter to a final value of 2 liters, would the same degree of dyspnea augment an initial value of 2 liters into a final value of 4 liters? I am not prepared to make definite statement in the affirmative, nevertheless there does seem to be that element about the effect of dyspnea. It is a sort of amplifier and, therefore, any other factor which adds to the minute volume has in exercise a significance beyond the face value owing to this effect of the dyspnea which follows and amplifies it.

The word "follows" if not actually used advisedly is used not quite casually. The events which lead up to exercise are often gradual and, as the result of suitable emotion contraction of the spleen, may precede the actual exercise, in which case the splenic increase of the minute volume would precede so much of the dyspnea as is caused by altered hydrogen-ion concentration of the blood.

Hemorrhage. Let us pass to the significance of hemorrhage in relation to spleen volume.

Striking as are the results produced by the injection of blood, the results produced by its withdrawal are perhaps more so. The withdrawal of 100 cc. of blood from a closed heart-lung preparation reduces the minute volume of blood from 1.5 liters per minute to 0.5 liter per minute. But so far as is known, a very early effect of hemorrhage on this intact animal is to produce contraction of the spleen and in the cat about one-fifteenth of all the blood may be taken from the vessels without any sensible fall in the volume of the circulating blood. Applied to a dog of 15 kilos, that would mean that 100 cc. of blood could be taken out without appreciably reducing the quantity of blood in circulation. After that 100 cc. had gone, the minute volume would commence to pay a heavy tax on every further cubic centimeter of blood withdrawn.

More Chronic Compensations. Apart from the rôle of the spleen in buffering mechanically the vascular system against sudden emergencies in the circulation such as those caused by hemorrhage, exercise, etc., there remained to be considered such questions as the rôle in pregnancy, intestinal operations, alterations in skin temperature, etc.

About these matters we know but little; a calculation made on the basis of some work by Uyeno[16] suggested that the total volume of blood which coursed through the skin vessels if dilated by heat

might be about 3 liters in man per minute. This is, of course, associated with a considerable increase in the size of the vascular bed in the skin vessels. Clearly these alterations could be effected without any alteration in the total minute volume of the total vascular capacity by the cutting off of blood from other areas. But to supply 3 liters of blood per minute to the skin would on that basis mean the diversion of anything from 40 to 90 per cent of this whole bloodflow to the skin and have little for the essential organs of the body. It seems rational, therefore, that if the vascular bed is enlarged the blood volume should be enlarged in proportion, that is to say, so that the blood exerted the normal pressure in the vessels. And indeed experiments, other than the original observations on our way to Peru,[17] have shown an increased bloodflow as the result of residence in a warm chamber. The provision of corpuscles to meet the increased bloodflow may be a legitimate function of the spleen; the matter could easily be tested on an animal with an extracutaneous spleen, but that has not been done.

Operations. We are still more in the dark as regards the shrinkage of the spleen in intestinal operations. Here the weak point in the argument is not whether or no the spleen contracts, but whether or no there is any commensurate increase to the vascular bed. This matter again is under investigation

Pregnancy and Heat. The evidence with regard to these alterations is on the whole more satisfactory than with regard to either postoperative shock or exposure to warm climates, because we know that we have both a large increase in the vascular bed of the generative organs and a decrease in the size of the spleen. The point unproven here is the actual increase in the blood volume in dogs. But insofar as it is legitimate to transfer information culled from one form of life to another, these experiments seem to form a natural complement to those of Rowntree,[18] who found a rise with vital red in the blood volume much beyond the amount of the fetus—the method was that of vital red injection which in any case could not by the very nature escape from the maternal blood. The rise commenced about the middle of pregnancy, the same time as did our contraction of the spleen.

Regulation of the Quality of the Blood. As Regards the Blood Count. Many observers now have studied the effect of contraction of the spleen upon the blood count—a problem which has been attacked in more than one way. The most direct attack was that

of Cruickshank,[19] who in the cat cut the splenic nerves and by tying nearly all of the anastomatic vessels reduced the lineal circulation to almost a simple system in which the blood entered the organ by the splenic arteries only and left it by the splenic vein only. He could then rapidly clamp the splenic artery, stimulate the splenic nerve and, collecting the blood which was evacuated from the spleen, determine its hemoglobin content. To give an example in which stimulation yielded 8 cc. of blood from the cat's spleen, the following were the hemoglobin values of each cubic centimeter, that of the arterial blood being taken as 100:

Cubic centimeter:—	1st	2d	3d	4th	5th	6th	7th	8th
Hemoglobin value . . .	100	104	120	135	126	..	108	96

These results show at a maximum an increase of 35 per cent in the red corpuscles and on the average about 15 per cent. The addition of 8 cc. of such blood to that of the whole animal would not appreciably alter the erythrocyte count of the blood in the general circulation.

The above results fall far short of what might be expected from the experiments of numerous investigators who have produced indirect evidence of the effect of the splenic contraction on the red blood count. Their procedure has been to institute some experimental condition, asphyxia, adrenalin injections, exercise, etc.; observe the consequent rise in the blood count and compare the results with that produced on a control splenectomized animal.

The most complete of such experiments are perhaps those of Scheunert and Kryzwanek,[20] who showed that the red count in the horse may rise from 6.01 million to 8.04 million on work. This means a 33 per cent increase in the red blood corpuscles. I cannot see how that could be effected solely by the spleen, even if the spleen contribution was 100 per cent corpuscles. Moreover, everything that we know about the mechanism of the body suggests that too large an alteration is only likely to be affected as the result of a combination of causes working in unison. Every adaptation is an integration.

Binet and his school have carried out a great many experiments of this type, of which the following by Binet and Williamson[21] is a fair example:

	Red blood cell in millions per c.mm.
Dog-chloralose:	
Normal before asphyxial crisis	7.4
Normal after five minutes' asphyxia	8.6
Normal before second asphyxia	7.7
Normal after five minutes' asphyxia	8.4
Dog-chloralose:	
Normal before first asphyxial crisis	8.0
Normal after five minutes' asphyxia	9.8
Splenectomized before second asphyxial crisis	8.8
Normal after five minutes' asphyxia	8.8

In a form of life so widely different from the mammals as the dogfish, Hall and Gray[22] have observed what appears to be essentially the same phenomenon. Reduce the oxygen content of the water in which the fish is contained, the spleen contracts and the red blood corpuscle count rises.

The question naturally arises, can such result be obtained on man? Himwich and Barr,[23] in 1923, showed that exercise in man raised the oxygen capacity of the blood; these observations have been confirmed by the subsequent work of Harrison, Robinson and Syllaba.[24] Pickering and Syllaba[25] have, however, tried the same experiment on a number of splenectomized persons, in whom they also obtain an increase in oxygen capacity. If there is any difference then between the normal and splenectomized individuals it is at most a small differential one.

Iron. One of the striking appearances exhibited, especially by unstained sections of the spleen, is that of a brown material known as hemosiderin. A good deal of controversy has taken place about this substance, first as to whether it is always in cells or is sometimes free, and, second, as to whether it is a compound more or less on the hematin level, as opposed to a compound of iron of a more simple nature. As regards the first point, I can offer no opinion. I have certainly seen it outside actual cells, but whether or not the cells which may have contained it broke down in the processes to which the sections were treated, I am unable to say.

As regards the nature of the pigment, it must be admitted that, as usually found, it does not give the usual tests for inorganic iron such as those with potassium sulphocyanate, potassium ferrocyanid or potassium ferricyanate. It does, however, give a black coloration with ammonium sulphate. The recent work of Stanley Cook[26] seems to indicate that in spite of these facts, hemosiderin is nothing more complicated than ferric hydrate, but in some sort of colored

suspension. Hemosiderin is seen not only in the spleen pulp, but often in large quantities in the sinuses which go to form the confluent of splenic vein and in the splenic vein chiefly it follows that when the spleen contracts such hemosiderin (that is, $Fe_2(OH)_6$) as may be in the venous sinuses and the vein itself is driven on. What becomes of it is as yet unknown. Nor is it known whether the number and strength of the splenic contractions have any influence on the rate of the production and, therefore, over any long time of its elimination.

The Fragility of the Red Corpuscles. Orahovats,[27] using essentially the same preparation as Cruickshank had done, studied the relative fragilities of the red blood corpuscles which enter and leave the spleen and obtained positive results. To graduated salt solutions, the corpuscles in the blood squeezed out of the spleen are more fragile than those of the general circulation. The interpretation of this observation is not very easy. One or both of two reasons might be ascribed. First, residence in the spleen might increase the fragility, or, second, the spleen might filter off the more fragile corpuscles. As between these two views, the evidence which he adduced seemed to favor that which seemed inherently least likely, namely, that the spleen exercised some kind of selection, and the facts would be explained if we assume that in proportion to its fragility the corpuscle has a greater chance of sticking in the spleen.

Though these experiments were suggested to us by those of Pearce, Krumbhaar and Frazier, who showed that the fragility of the corpuscles varied for some time after the spleen had been cut out, and though our results are what might be expected, they will, I think, agree with me that the ultimate interpretation of both is not at all certain.

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S. WEIR MITCHELL*

By JOHN H. GIBBON, M.D.

On February 15, 1829, at 119 South Fifth Street, there was born a son to a distinguished father, a son destined to become the most prominent figure in American medicine. In considering the lives of Dr. John K. Mitchell and of Dr. S. Weir Mitchell one cannot fail to feel that the characteristics of the father—his marked professional ability, his literary tendency and his social charm—reached their culmination in the son. Mrs. Burr, in her recent book, *Weir Mitchell, His Life and Letters*, has given us a delightful picture of the family life of two generations of Mitchells. In each there was a conspicuous sympathy and *camaraderie* between the grown-ups and the younger generation, a situation but rarely encountered at the time. Of course, this intimate companionship between parent and child is much more common now and makes for the happiness of each. One has but to read the letters written, usually on Sunday afternoons, by Weir Mitchell to his two boys when they were away at school, to get a glimpse of the intimate and sympathetic relationship between father and sons.

Every Fellow is familiar with Dr. Mitchell's scientific accomplishments, and all save those elected in recent years can easily bring before their mind's eye a picture of this dignified and handsome figure as he walked into this hall and sat in one of these front seats. Many among us can recall little and big acts of courtesy and kindness which he was always ready and happy to extend to the younger members of our Fellowship. Mrs. Burr has depicted these sides of Dr. Mitchell's character, but has, in addition, given us a very intimate picture of all of his activities—medical, literary and social. His own unfinished autobiography is freely quoted and adds greatly to the value and interest of the book.

Many have supposed that Mitchell's early life was one of comfortable ease; that his beginnings in medicine were rendered smooth

* Read November 6, 1929.

by a prosperous and popular father. This is not true. His early professional life was beset with difficulties, with responsibilities and with disappointments enough to have discouraged a less-determined and less-courageous character; but these were forgotten or overcome and his career was crowned by a success and by honors which few acquire. His first disappointment after graduation was his failure to obtain an internship at the Pennsylvania Hospital, and his second, a far greater one, was his defeat for the chair of physiology at Jefferson College.

His father was far from being enthusiastic over his decision to study medicine, saying to him: "You have no appreciation of the life. You are wanting in nearly all the qualities that go to make success in medicine. You have brains enough, but no industry." It is evident from this that the father at this time had no more appreciation of the latent qualities in the son than had, later, the managers of the Pennsylvania Hospital or the trustees of the Jefferson College. His was undoubtedly a character which was stimulated and grew under disappointment and obstacles.

When he had graduated in medicine his father again misjudged his abilities and tendencies, and advised him to take up surgery, a field of medicine for which he says he had no inclination and none of the qualities which lead to success. In the diary we read:

> "I had been placed in Doctor Mütter's office. It was my father's wish that I become a surgeon, but surgery was horrible to me. I fainted so often at operations that I began to despair. Moreover my hands were awkward."

But he was himself undecided as to just what type of work he wanted to do and undertook to follow parental advice. With this object in view, he spent about a year in England and on the Continent; but, owing to poor health at this time of his life, the trip could hardly be described as a success. It is true he dined at the house of Jenner and made the acquaintance of Paget, Quain and other celebrities, but we hear very little of surgery. In Paris he took the courses in surgery, but he "liked much better the lessons of Bernard in physiology and Robin in microscopy," and shortly after his return to Philadelphia we find him teaching physiology in a summer school. His interest in this science was so great that he would have devoted his life to it, I am sure, but for these events: his failure to

obtain the chair at Jefferson; the death of his father, leaving the family with but modest means; and the Civil War. Had he been able to follow his bent, neurology would have been a heavy loser. Probably the situation in which young Mitchell found himself at the death of his father, whom he called "my best friend," is best described in the following excerpt from his diary. Speaking of his father he says:

"He had lived very freely, after the Virginia method or want of method, and on his death, in place of an ample estate, there was not sufficient for the proper support of my mother and younger brothers; my sisters, with the exception of Elizabeth, having already married. Of this I do not complain. Unless life had so burdened me with duties and obligations, I should have lost an invaluable discipline, but all this made me resolve to secure at least a comfortable competence and taught me lessons of care and self-restraint as to money, for I inherited my father's tendency to extravagance. Toward the close of his life, my own practice had been increasing out of proportion to my years, for, though people saw my father's state of failing health, they believed he was still back of me with any aid I might need. I was making at that time about two thousand dollars or more a year; but the year after his death a large number of persons who had accepted me when he lived left me, and my practice dropped to a thousand dollars, so that I thought that my work had been seriously impaired.

"From that time on, however, my practice slowly increased and I was enabled still, at great cost of such labor as few men give, to carry on some of my scientific work. After the War began I ceased to do much laboratory work and gave myself up to my profession."

In contemplating the life of Dr. Mitchell and his remarkable success in many cases where others had failed to bring the patient back to health and happiness, I am convinced that much of his success was due to an unusual comprehension of the sick man's mental attitude. It was, I think, this quality more than anything else which enabled him to estimate the extent which "nerves" play in disease. The word psychology has been much abused and cheapened in our day, and is often used, especially when hyphenated with another, as if it indicated some new discovery; but using the word in its real sense, I would say that S. Weir Mitchell was a great psychologist and, having a wide knowledge of general medicine and being in addition a real scientist, he was as a natural result no mean analogist. Not only did he possess this too-rare and valuable faculty, but passed it on to others. Many a man in Philadelphia

who has succeeded in his profession and has been honored by it, owes much of his success and honors to an early association with this great physician. Had I to estimate the value of a medical life I should want first to know what influence it had on its contemporaries and on the younger members who were in intimate contact with it. In the case of Dr. Mitchell this information could be readily and heartily supplied by Dr. Keen, by Dr. deSchweinitz, by Dr. William J. Taylor, by Dr. William G. Spiller and by scores of others.

This opportunity would be misspent and my duty poorly done if I did not say something of Dr. Mitchell's relation to this ancient institution, which has lost no chance to honor him and which he always honored. Perhaps no Fellow in its long history was more sincerely devoted to it and no one certainly ever did so much for it. He was generous not only with his money, but with his valuable time. Its welfare, whether he was at home or abroad, was ever in his mind. He was familiar with every nook and cranny of the old library at Thirteenth and Locust and of this one. He knew the books we had and the ones we needed. It is largely due to him that we are now housed in these comfortable quarters. He gave money himself and inclined others to give large sums for the erection of this building, and this without noise and annoyance in the good old days when one did not talk of "prospects" and "contacts" and when one did not "sell" ideas.

Dr. Mitchell loved the social side of life, of which he was a conspicuous ornament, and it is not surprising that he should have left to the College a sum of money the income of which was to defray the cost of College dinners when the Fellows might gather for social intercourse. This he believed would help to keep alive, at least in part, the spirit of the College. Dr. Mitchell served two terms as President of the College, an honor conferred on but one other Fellow, his friend, Dr. J. M. Da Costa. If I were asked to state the greatest need of the College today I should say another Weir Mitchell.

I have said nothing of rattlesnakes, of gunshot wounds of nerves, of rest cures, of *Hugh Wynne,* of poetry, of salmon fishing and mountain climbing, because these are all familiar to you and have been talked of many times within these walls; but I have rather tried to speak of things probably less familiar, at least to some of

you. A very delightful elaboration of all these you will find in Mrs. Burr's book.

It is to honor the memory of this great physician that we are gathered here tonight on the one hundredth anniversary of his birth.

S. Weir Mitchell died at 1524 Walnut Street on January 4, 1914, and shortly afterward the College established a lectureship in his honor, to be known as the S. Weir Mitchell Oration, and I now have the pleasure of introducing a distinguished neurologist, Dr. Frederick Tilney, of New York, who will deliver the fourth oration, entitled "The Structural Basis of Behaviorism."

THE STRUCTURAL BASIS OF BEHAVIORISM*

The Weir Mitchell Oration

By FREDERICK TILNEY, M.D.
NEW YORK CITY

"I then resolved I would devote myself to human welfare as a practitioner of medicine, in particular to maladies of the nerves, the mind and behavior or feeling reactions, to their remakings and reconstructions."†

S. Weir Mitchell.

Introduction. The sincere American upon coming to Philadelphia must always feel that he has entered a shrine of our dearest traditions. He cannot fail to be moved by a deep sense of reverence and grateful thanksgiving. Such are my feelings—and something more. My journeys hither have always been to do homage to the Lares and Penates of the medical household to which I belong. The names of Mitchell and Mills, Dercum and Burr, Spiller, Weisenburg and Frazier are household words throughout the land. They are especially dear to me.

America's First and Greatest Neurologist. In spite of the fact that at one time within your dignified precincts it was a positive disadvantage for a man's reputation to have "a great many New York friends," it is none the less my great honor and distinction to speak in heartfelt appreciation of the Philadelphian who, among many other things, is America's first and greatest neurologist.

His life and its influence have now reached the century mark. We may now see clearly what Weir Mitchell was and what he has become. In this memorial hall, in this great city and throughout the nation his presence is still with us. There is no passing of the great. Lives which have long since departed the flesh still live beside us as our guides and inspirations. With the years they grow and hold us all the more. This is the immortal legacy bequeathed to us by our great leaders.

* Read November 6, 1929.

† From Personal Glimpses of S. Weir Mitchell, by J. Madison Taylor, M.A., M.D., Annals of Medical History, September, 1929.

A certain type of greatness depends primarily upon aggressive and acquisitive personality. From it have arisen the conquerors, the builders of empires, the captains of industry. Another type has been primarily active in the diffusion of benefactions arising from no less strenuous but more contemplative devotions. Of this kind is Weir Mitchell's greatness. Besides this, he possessed another element rare among men of his caliber. Many have earned their claim to distinction through the expression of some one superlative capacity. Some have excelled in several ways. Few have had such versatility in greatness as Weir Mitchell. This is the keynote of his exceptional distinction. His was the gift to draw from a large capital of talents. He directed his efforts through many channels of effectiveness. As a scientist, as a man of letters and a poet, as a man of affairs and as a great physician, he advanced the welfare of mankind. Preëminence in any one of these fields is usually distinction enough. He was preëminent in them all.

Influences of Heredity and Evironment. His history is an inspiring revelation of pertinacity, of boldness, of courage, of many-sidedness and of calm sureness in himself. He illustrates, also, the effects of heredity and of environment. His father, a distinguished physician and scientist, exerted a strong influence upon him through long years.

Dr. Mitchell was not in any sense a self-made man, because Nature literally showered him with the gifts of superior manhood. He was, however, a self-made genius, for he never neglected the slightest detail in a program of taking infinite pains. He had and responded to the irresistible drive to be what he was so well fitted to become. In his earliest days, long before science had established an attractive reputation, he gave himself over to his strong research inclinations. He was more intent upon investigations in physiology than upon medical practice. It was his original aim, in fact, to devote his life to physiological investigation. His first work, carried on through long night hours of toil after his medical duties of the day were done, resulted in many notable contributions to comparative physiology. It led him into researches upon the venom of the rattlesnake and studies of the anatomy and physiology of the organs concerned. This pioneer work in toxicology was to prove the foundation stone of our present knowledge as to the nature and treatment of reptilian poisons.

The daring and devotion of his enterprise in science is clearly

shown by his reaction to the advice received by him from one of his professorial friends. He was enjoined to desist from his researches and assured that it was nonsense to bother himself about snake poisons. Another professor warned him that every experiment in the laboratory would cause him the loss of a patient. His only comment was, "I did not think so." And time has surely proved that he was right.

Pioneer Work in Neurology. Those years of research toil were not without their productive effects in another respect. They prepared those ample mechanisms and that attitude of mind upon which were based his next great contributions. After ten years of arduous effort in his early medical career, the Civil War broke out. He was then commissioned to take charge of the Turners Lane Hospital for nervous diseases. Here he displayed all of his scientific inclinations, in consequence of which he became the pioneer in this country of modern neurology. His remarkable work in dealing with war injuries to the nervous system will stand as a classic for all time, not only for the penetrating exactness of his observations, but equally for the clarity, force and simplicity of his presentations.

His pioneer work, however, was not to cease at this point. As the years passed and the wounds of our great civil conflict healed, he recognized the growing American malady due to nervous overstrain. At first he called attention to the effect of such strain in the relation of the eyes to headache. Later, he converted this conception into a much more general application and devised what not only brought to him world fame, but to many others worlds of relief from suffering—the rest cure. Through all of this steady advance it was his early scientific impulses which still spoke and led him onward. In later years, when he had reaped the rewards of his medical contributions, he gained a new and more widespread renown through his efforts as a writer of fiction, an essayist and a poet. American literature has been deeply enriched by his pen, and his writings both in prose and in verse are among our most treasured possessions.

In Addition to Science and Literature. His gifts were not limited to these tangible arts. He had what amounted to a genius for friendship and friendliness, out of which grew a host of devoted friends and loving admirers. Yet through it all, as scientist, as wartime surgeon, as man of letters and poet, as devoted friend, Weir Mitchell was always and above all the great physician. However much he may have stirred the imagination of his fellow-country-

men at large, however much he may have charmed and delighted them with his storytelling, it was most of all upon medical conscience that he has impressed the stamp of his life.

His own day acclaimed his genius. This generation reveres him for his example, his achievements, and the future—for all of these reasons—will say that he still lives.

We see him at last full of honors and years, in the genial satisfaction of a life spent in splendid effort, in the warm afterglow of success which had denied him little in the way of blessing. He still possessed all of his personal charm and magnetism. Almost to the end his powers to express his deeper feelings retained their force and simple beauty. He was still able to make vibrant the emotions of his affection and pride, as when he wrote to express his confidence in the ability, judgment and wisdom of another distinguished physician, his own son, saying in his will: "I leave you my love; I have never loved any man as I have loved you, and I shall love you still."

Genesis of Modern Behaviorism. Under the ægis of his broad, scientific sympathy we may make bold to approach a modern, albeit a controversial theme. Whatever his own feelings might have been concerning this subject, we may be certain that his attitude would have been generous, his judgments impartial.

Psychoanalysis had not advanced sufficiently to stir his active days. Nor had modern behaviorism, which is still younger, become an engaging subject of discussion. Only as late as 1912 did it take on substantial existence when its chief exponent, Prof. J. B. Watson, announced its tenets. At that time it had the sound and many of the earmarks of another "ism." Since then it has passed through a fire of criticism, but it still survives. Today, in spite of a host of ardent critics, it has gained and is gaining an increasing number of staunch adherents.

Behaviorism is generally regarded as the fruit of a recent quarrel with psychology. Such it may be. By more exact estimate it seems to be an outgrowth of the modern critical spirit—a part of present-day skepticism. It surely has been fathered by the thoroughly contemporaneous desire to strip off our traditional delusions. Dr. Watson and many others have felt that psychology as a branch of human interest has been especially restrained by those great bulwarks of mediævalism, traditional religion and philosophy. Other specific interests, like chemistry and physics, have succeeded in

freeing themselves. Psychology still remains enslaved. It has failed to gain its freedom largely because its subject matter and choice of method are limited. "States of consciousness," says the sponsor of behaviorism, "like the so-called phenomena of spiritualism, are not objectively verifiable and for that reason can never become data for science." In other words, the subject matter of psychology up to very recent times must now be excluded from the field of exact knowledge.

The entire controversy issues from this attitude. As it proceeds it affords notable revelations of human behavior. One realizes, indeed, how difficult it is to be just; how easy to be carried away by personalities and partialities.

THE BATTLE OF BEHAVIORISM. Let us examine for a moment a few samples of behavior drawn from a publication of the current year entitled, *The Battle of Behaviorism.* This is the record of a debate between two well-trained scientists. The illustrations themselves will prove more than interesting. They are indicative of much in the general nature of human reactions, as they also reveal the general predispositions of the contestants.

Dr. Watson asserts that McDougall's *Outline of Psychology* represents a lazy, armchair type of psychologizing.

Dr. McDougall: "Watsonian behaviorism is a peculiarly American product. It may even be claimed that it very clearly bears the marks of the national genius for seeking short cuts to great results."

Dr. Lashley describes Dr. McDougall as "bouncing back and forth between accurate description and the exhortations of a soap-box evangelist."

Dr. McDougall: "I am sorry for Dr. Watson, and I am sorry about him; for I regard Dr. Watson as a good man gone wrong. I regard him as a bold pioneer whose enthusiasm in the cause of reform in psychology has carried him too far in the path of reform; one whose impetus, increased by the plaudits of a throng of youthful admirers, has caused him to overshoot the mark and to land in a ditch; a false position from which he has not yet summoned up the moral courage to retreat."

Dr. Watson: "McDougall returns to religion."

Dr. McDougall: "I cannot stop to refute these dreadful charges. I must be content to assert flatly that I am a hard-boiled scientist, as hard-boiled as Dr. Watson himself and perhaps more so."

Such matter as this is unquestionably the stuff of which human behavior is made. The definition of behaviorism is most explicit on this point. The objective observational method of approach is also the approved one. Watson insists that introspection, as the principal method of psychology, is a serious obstacle to progress. This method is no longer serviceable. It has outlived its usefulness —if it ever had any. At best it has never been able to accomplish more than the analysis of mental states into irreducible units of sensation and affective tone. Yet this achievement in itself is inconsequential, because no other human being can make an introspective observation upon any one but himself.

Thus consciousness and introspection, the very essence of conventional psychology, are swept away. Indeed, we are cordially invited not to consider ourselves behaviorists unless we can wholeheartedly subscribe to this complete elimination.

Definition of Behaviorism. According to definition, behaviorism is presumed to be, first of all, psychology at length converted into a natural science. "It takes human behavior—the doings and sayings, both learned and unlearned, of people as its subject matter. It is a study of what people do from even before birth until death."

Behaviorism is thoroughly and exclusively objective. Through observation and experiment, it endeavors to find the principles which underlie changes in behavior. These changes it ascribes to the operation of certain stimuli or situations which produce definite responses. It assumes, even if somewhat loosely, the existence of a specific mechanism for transforming these stimuli into corresponding responses. And above all, it insists that the entire body, in all of its component elements, is essential to such reactions.

The behaviorist is unwilling to remain within the realm of pure science. He has a practical goal. It is his belief that only systematic, long-sustained, genetic studies upon the human species, begun in infancy and continued until past adolescence, will ever give us experimental control over human conduct, so badly needed both for general social regulation and for individual happiness.

Pattern-reactions of Response. The stimuli of the behaviorist embrace all manner of influences inside and outside of the body which are capable of provoking responses. The responses, on the other hand, are much more limited in their nature. They appear in two principal groups; unlearned reactions, which are hereditary

modes of response and which are recognized as emotional or instinctive in their expression.

An emotion is described as an hereditary pattern-reaction involving profound changes of the bodily mechanism as a whole, but particularly of the visceral and glandular systems. In man the earliest emotions to appear—and hence, perhaps, the most fundamental—are fear, rage and love. Each of these has specific stimuli or situations to arouse it.

An instinct is also an hereditary pattern-reaction resulting in movements of striped muscles. Most of these reactions are adaptive and useful, although many of them have no such significance. Watson, in the main, concurs with the statement of William James that "the actions we call instinctive all conform to the general reflex type; they are called forth by determinate sensory stimuli in contact with the animal's body or at a distance in his environment." Watson further agrees with James in holding that "the older writings on instinct are ineffectual waste of words, because their authors never came down to this definite and simple point of view, but smothered everything in vague wonder at the clairvoyant and prophetic power of animals—so superior to anything in man—and by the beneficence of God in endowing them with such a gift. But God's beneficence endows them, first of all, with a nervous system; and turning our attention to this makes instinct appear neither more nor less wonderful than all other facts of life."

These instincts are man's hereditary assets, his untutored ways of living. Of still greater volume are his learned reactions, which he acquires through experience and which constitute his habits.

Exclusions of Behaviorism. By thus turning its back upon introspectively observable fact and completely eliminating consciousness, Watsonian behaviorism forces itself into an extreme position from which it is difficult for it to deal with much that is veritable and universally accredited in our lives. It resolutely ignores all such facts as feelings of pleasure or pain; pitying, despairing or grieving; of desiring, striving or choosing; of remembering, imagining or dreaming; of planning, foreseeing or predicting. Such a policy follows the counsel of exclusivism.

It is often true that the enthusiasm of the reformer creates the extremist and thus works harm to the cause he may espouse. Such seems to be the case in this instance, as it has been in many others.

What Watson, for example, has done to and for behaviorism, Freud has done to and for psychoanalysis. Yet it would be unfortunate to lose the truly valuable purposes expressed in these two methods of psychological approach. To obviate such loss it has been suggested that the modern brands of these methods now in vogue be designated respectively Watsonism and Freudianism. This suggestion is entirely free of any intention to belittle the great services rendered by Watson and Freud. It aims solely to protect behaviorism and psychoanalysis against the outgrowths of extremism, and, by so doing, to preserve them for further and wider usefulness. Indeed, Dr. McDougall has no quarrel with what he terms sane behaviorism or the behavioristic psychology, of which he believes himself to be the chief begetter and exponent. It is his claim, regarding the behaviorism which is approvingly referred to by many contemporaneous writers, that he rather than Dr. Watson is the archbehaviorist.

Influence of Behaviorism. The effects of behavioristic influences, however, are now clearly apparent. The older conceptions of psychology as the study of the soul, of the mind, of the vital principle or of the essence of life have been largely modified. According to one of the most recent interpretations, as given by Prof. Woodworth, psychology takes the individual as a whole and studies his activities. It keeps its eye fixed on him as he plays his part in the group. It inquires into the general laws of behavior; of learning, thinking, feeling, moving.

Because psychology studies activities, its principal terms must be verbs. The individual or animal is the subject of these verbs, out of which have grown many nouns as the names of activities. These names—such as consciousness, intelligence, thought, memory, imagination, sensation, emotion and behavior—have first been deified, then fought and bled for throughout a voluminous literature. We have seen not a little of this psychological bloodshed already. Much strife and controversy might be avoided if these nouns were constantly thought of as verbs. Instead of *thought*, we would better indicate the activity implied by saying "thinking;" instead of *memory*, "remembering;" instead of *sensation*, "seeing" or "hearing."

"Intelligence, consciousness, the unconscious," according to Woodworth, "are by rights not nouns, nor even adjectives or verbs; they are adverbs. The real facts are that the individual acts intelligently—more or less so—acts consciously or unconsciously,

as he may also act skilfully, persistently, excitedly. It is a safe rule then, on encountering any menacing psychological noun, to strip off its linguistic mask and see what manner of activity lies behind."

In this light the efforts to abolish consciousness seem somewhat quixotic. They are not, after all, dealing a deathblow to an imposing philosophical noun; they are merely belaboring a humble adverb.

Field of Modern Psychology. Animal activity, human and subhuman, seems to be the field as psychology now sees it. In this broader acceptance there are no prohibitive restraints to be put upon the approach to this field. Any controlled method is acceptable which brings with it a fair promise of revealing the truth. No one method holds the only key for solving its problem. Objective behaviorism covers an important sector. There are certain depths which it cannot reach, however, and in many of these introspection has its value. The methods of the psychoanalyst, psychiatrist, purposivist, experimentalist and configurationist have their distinct usefulness and application. It is recognized that this attitude puts us utterly beyond the pale, according to the rules laid down by Watson. Yet even with these latitudinarian beliefs we may study the structural basis of behavior—the mainsprings of objective doings in animal life—assured that we are well within the fold of approved modern psychology. But it is equally true that modern psychology may never hope to solve the problems which it has thus assigned itself without thorough biological studies of the body and particularly structural studies of the nervous system.

Intricacies of Adult Behavior. One of the difficulties in analyzing the sayings and doings of human behavior is the great complexity of normal adult life. Not only does individual existence express a great variety of responses, but its exciting stimuli arise from a perplexing maze of circumstances. For this reason the behavior of each individual forms an intricate mosaic of reaction-patterns all but defying analysis. The problem is further complicated by the many varieties of disciplines by which life is conditioned and the numerous channels of activity into which human effort is directed. All of these conditions vary greatly and make it impossible for the total behavior patterns of any two individuals to be entirely alike. In consequence it is not an easy task to establish principles which will serve in the adult as a satisfactory basis for analysis. This is the reason why most modern studies of personality makeup are

unsatisfactory. Adult human behavior seems largely beyond our powers of analysis. We may attempt to interpret it, but when we do so we are far from the sources from which human behavior springs.

The Stream of Behavior. Because it is the expression of organic life, behavior has a definite genesis. In this respect it resembles the organs upon which life depends. Like all of the organs it has a definite beginning. This beginning is the expression of behavior in its simplest terms. Then follow successive stages, each characterized by definite additions. Ultimately, by this successive increment, there is built up a stream of reactions which flows through the existence of the individual and constitutes the total behavior. But this stream does not come all at once to its full adult dimensions. Little by little, and one by one, new elements are added to swell its volume. Some elements which appear at early periods are withdrawn. In the main, however, it is the tendency of this stream to increase, rapidly at first, more slowly later, throughout the effective periods of life. It is clear that such a stream must be the least complex at its beginnings. It is here that the efforts to unravel the problems of behavior may be made with best hope of success.

Phyletic and Prenatal Elements. There is an undeniable simplicity in the actions of the child as compared with those of the adult. Yet in order to reach the actual headwaters of human reaction we must go still further back than childhood, seeking the principles underlying human response in the actions observed immediately after birth. Indeed, we are not even then at the actual source, for behind birth there stretches a long period of reactive phenomena under the influence of prenatal conditions. When, therefore, a full and satisfactory explanation of human behavior is ultimately forthcoming, it will comprise the revelation of all facts concerning the reactions and interreactions of those tissues and organs which form the body from its earliest beginnings. Even such a comprehensive understanding of the genesis of this stream of human behavior would leave much to be desired. The moment we invoke the principle of heredity, we open a great biological vista, and believing, as modern intelligence compels us to believe, in the evolutionary process, we must accept the existence of a behavioral evolution just as we have accepted that of an organic evolution. It is not sufficient to understand the reactions of the human infant, of the

fetus, of the embryo. The genesis of human behavior extends back of these stages through millions of years. It has been subject to all the vast influences of vertebrate life from its early paleozoic beginning. It bears the impress of primitive aquatic adjustment and later accommodations to life upon land. By the process of heredity it has carried onward the effects of many reptilian and many more mammalian adaptations. At length it passed through the mold of arboreal life during the specializations of the great order of primates. It is preëminently stamped by those behavioral accessions which, over and above the activities of mammalian and arboreal existence, have ultimately led the way to humanity.

The secrets of human behavior are not to be found in man alone. The explanation of much of its rich superstructure is revealed by human ontogenesis, but the great basic principles underlying human reactions must be sought through all the stages of man's long vertebrate ancestry. All of these are most important leads for the further understanding of our behavior. They bring us directly to the investigation, not merely of the slow upbuilding of reactions in man, but equally, and perhaps more fundamentally, to the study of behavior as it has gradually unfolded through the long complex development of life upon our planet. Such a program of investigation indicates how little we have accomplished; how much yet remains to be achieved. In this extensive enterprise to understand ourselves, the surface has barely been scratched. Indeed, this greatly desired understanding is almost certain to be long in coming. The past century has seen its early dawn. Henceforth every attempt in this direction, however humble, must be regarded as a step forward.

The Transformer of Neural Energy—The Brain. It must not be overlooked that behavior depends upon the animal as a whole. No part can be excepted from the operations necessary to carry on existence—the limbs with all of their muscles and bones, the body with all of its organs, the head with its sensory equipment and central controlling mechanism, contribute to the never-ending interplay of reaction and interaction in the sum total of animal behavior.

But among these parts of the body there is one which stands preëminent because it is the transformer of those impulses arising from stimuli into impulses provoking response. This part, the brain, has been slighted by the behaviorist only a little less than

consciousness. Any adequate conception of behavior must first recognize this organ as playing a leading rôle.

Problem of the Present Study. The problem to be considered may then be specifically stated: What is the relation of the ripening or maturing of the brain to the development and maturing of behavior? The brain has been especially selected since it is that part of the nervous system which represents the highest developmental possibilities. It also has control of the most effective elaboration of stimuli and the production of the most complex responses. Since the evolutionary heritage of man is recognized, one necessary step in approaching this problem is the study of the behavior and brain development in lower animals. Such a procedure will establish certain principles and should reveal many basic traits common to all vertebrates, including man. These studies may then be carried forward into the human sphere and applied to the infant.

It is the purpose of the present investigation to deal largely with the brains of some of the higher mammals. The mammal is especially important as forming the last link in the progressive advance toward man. Its brain contains the latest element of neural organization, namely, the neopallium, or cerebral cortex, from which man derives his supremacy. None of the vertebrates below the mammal possesses this neopallium, the appearance of which marked a biological advance of the first order.

Procedure and Methods. Among the mammals most easily observed and studied through the stages of gestation, delivery and postnatal development, none is more satisfactory than the cat. This animal, because of its domestication, obviates many difficulties in observation. It is especially favorable material for experimental control, and it may, therefore, be selected as a suitable form upon which to base our postulates.

The procedure followed includes the study and reactions of the animal at and during the time of birth and through the several stages of postnatal progress. It also affords evidence concerning certain prenatal reactions. Its immediate object is the exploration to disclose the adequate stimuli which produce the responses observed in different periods of growth. Observations may be easily checked by the simultaneous study of several workers. Exact records of reactions may be made by means of motion pictures, using both the ultra-rapid and the ordinary cinematic exposure.

Each separate reaction is for convenience called a *behavior component.* Progressively, day by day and week by week during the growth of the animal, new behavior components make their appearance, until their sum, up to and including the time of sexual maturity, has entered into a composite which forms the animal's adult reaction stream. During the process of this development some primitive reactions seen in the early stages disappear or are incorporated in more adequate mechanisms for response. Throughout this developmental period the brain was studied with the purpose of detecting the new structural mechanisms perfected to carry on each new behavior component. Special attention has been given to the correlations of pattern-reactions and the maturing of the cerebral cortex. Similar correlations have been sought in relation to the maturing process in the nerve fibers. Electrical stimulation has also been employed in order to test the facility of the brain to react to artificial excitation at different periods of growth.

Origin of Cerebral Cortex. The ripening process in the cerebral cortex leads back to a stage of the utmost simplicity. It is essential to make a starting point at this stage. The end-brain has just emerged from the side of the neural tube as a thin-walled sack. This sack consists of a dense layer of deeply staining cells enclosing a large cavity. It is interesting to note the events transpiring in this layer. By an active process of reproduction many cells are being developed which then migrate toward the outer surface of the brain sack. Outside of this rapidly proliferating layer is a narrow homogeneous zone which contains very few cellular elements. This is the marginal zone. The thick inner layer (ependymal layer) is at once a progenitor and an incubator. In it are developing all of the cells destined to produce the mechanisms necessary for receiving stimuli and sending out impulses to produce response. This is the condition of affairs in the embryo kitten 10 mm. in length (a little over $\frac{2}{5}$ inch long). The action of this animal in the mother's uterus is almost entirely that of a parasite. Only the feeblest signs of circulation are present. When the embryo is scarcely more than $\frac{1}{2}$ inch long (14 mm.) the wall of the end-brain has changed. Instead of two distinct layers it now consists of three strata. The inner parent layer has altered only a little; but from it, in the direction of the marginal layer, there have migrated a large number of cells which now form a third or middle layer (mantle layer). This mantle layer is of utmost importance.

In it develop all of the cells which finally act as the receivers, transmitters and dispatchers. These elements eventually form the cortex, and by them the animal will be governed in all of its most intricate and complex reactions. As growth proceeds, and while the embryo is still less than an inch long, the brain wall again changes. From a simple sack of three layers it now consists of five strata.

Brain and Reactions of the Embryo. The embryo itself is still an intrauterine parasite with a feeble circulation, and beyond this it has little or no reaction of its own. The brain is a structure merely in the bud. There are no indications that this embryonic brain or the central nervous system as a whole has yet taken over any extensive control of the new life. For that matter, there is very little in the new life which requires such control.

Of all the new developments in the brain, the cortical layer is the most striking. It has migrated far out from the inner parent layer. A dense mantle zone and a looser intermediate layer now separate the inner and cortical layers. The cortex cells are arranged in cords or chains, the axes of which are at right angles to the marginal layer. This arrangement is particularly significant. It points to two future developments of much importance: (1) it shows the direction which the cells in these cords will take in their further migration; (2) it foretells the ultimate shape which they will assume when they become full-grown.

Many small oval cells stream out from the parent layer into the intermediate stratum. The meaning of these elements is interesting. They differ considerably in size and configuration from the cells which are seen in the cortical layer. They have but little orderly arrangement as they migrate from their source of origin. These cells ultimately form the supporting tissue, the cellular matrix in which the active nerve cells and their fibers are embedded.

Steps in Forming the Neopallium. A little farther along the road of development, when the embryo is 2 inches long (50 mm.) and is still dependent upon the mother for its existence, conspicuous signs of progress appear. Cell cords are still prominent in the cortical layer, but marked advances are seen in each cord. The cells at the inner end of the cords have become distinctly larger, and are now pearshaped. Those at the outer end remain small. The larger inner cells are beginning to move away from their respective cell cords. A second change is the appearance between the cords, and apparently derived from them, of numerous oval cells with

large nuclei. At this stage it is possible to foresee the development of all the varieties of pyramidal cells which are the active receiving and despatching elements in the cortex. The oval cells give rise to the stellate or connecting cells. All of the elements necessary to the cortex have now appeared. Still immature, and as yet giving no evidence of any capacity to act, they are, as it were, only in seed form.

There now follows that critical phase immediately preceding birth. The animal is soon to assume the duties of independent living. Its parasitic activities will cease. It is about to become an individual in its own right. At this time the kitten is about 5 inches long (125 mm.); it is covered with hair; it is fully formed and recognized as a representative of its species. Its heart is in full action. It is carrying on all of the processes of a complex metabolism in relation to its placental circulation. It even makes a few jerky movements with its body and limbs, especially with its forelimbs. Its eyes and mouth are closed, and it makes no attempt to breathe. Yet this living member of the cat family is about to be born, to be initiated into a new and separate life of its own. In many respects its brain has developed remarkably, as we shall see in later observations, but its cortex, that part of the brain ultimately to become supreme in the control of behavior, is still in the ripening process. It is yet far from mature, and its immaturity is especially significant because there is no reaction on the part of the animal at this period just before birth; no action, in fact, immediately after birth, which requires the authority of the cortex to start or direct its performance.

Foundations of the White Matter. Many important changes, however, have occurred in the cortical layer. All of these indicate the course of events which must follow in order to bring this ultimate regulator of life to full maturity. The first of these changes has caused a great increase in the thickness of the brain wall. It is due to the rapid invasion of the intermediate zone by axis cylinders. Each axis cylinder is a conducting process from a nerve cell. It carries nerve impulses. Billions of nerve cells have sent out such processes into the intermediate layer, where they eventually form the medullary or white substance. At this time these conducting processes of the nerve cells have no insulating substance. One fiber lies in close contact with several others. Such an arrangement does not permit the most effective conduction. At this stage, immediately before birth, therefore, the end-brain has

acquired the important foundations of its intercommunicating systems, the white matter.

Appearance of Pyramidal or Executive Cells. The cortical layer has now developed one of its distinctive features—the pyramidal cells. All of them bear a strong family resemblance, but some are small, some are of medium size and some are relatively large. This cortical layer still is arranged in cell cords. The outer portion of each cord is much the densest and the cells here are the smallest. The cords are five or six cells deep. They are practically parallel to each other and the axis of each cord is approximately at right angles to the surface of the brain. At the inner end of the cords the cells are large and have a distinctly pyramidal form. They have moved away from the ends into a deeper position in the cortex. Between the small cells and the large cells there are numerous intermediate elements, all, however, of pyramidal shape. Scattered among the pyramidal cells are many oval elements, in addition to smaller cells of the neurogliar type. Lying still deeper in the cortex are certain very large pyramidal cells, or giant cells. They are pearshaped and have polar processes at right angles to the surface of the brain. The appearance of pyramidal cells in the ripening cortex is of great significance. It means that all of these cellular elements have now become polarized. They are getting ready to receive and to transmit nerve impulses and thus to fulfil their executive functions in the direction of behavior.

Many billions of cells have appeared in the cortex during this complex process of ripening. Each of these cells is required to take its allotted place. Each of them will be required to make its proper connections. Since many factors have been operative in this process, it becomes apparent what a great range of possibility there is for the development of irregularities, suppressions or perversions, all of which may, by affecting the proper maturity of the cortex, produce corresponding irregularity, suppressions or perversions in behavior. In this light the period of gestation becomes one of greatest importance in its bearing upon the future development and prosperity of the newly-produced offspring.

The Brain of the Newborn. The development of the brain after birth and the progress of behavior may now be followed. For this purpose two distinct regions of the cortex have been selected.

One of these regions, the motor area, is related to skilled reactions, such as hunting and climbing, and all of the precise movements

which the cat performs in carrying on the complex purposive activities of its daily life. This type of movement in the cat matures slowly.

The second type of cortex has to do with the function of seeing. This is the visual area. It passes through its ripening process somewhat more rapidly than the motor region.

The kitten when born is apnœic and motionless. The placenta is delivered shortly after the delivery of the animal. Thereupon, the kitten becomes an independent agent. It must depend upon itself both in obtaining its oxygen and in getting rid of its carbon dioxide. It has not, however, as yet established its own respiration. In three or four minutes it makes vigorous gasping movements at intervals of ten to fifteen seconds. Five minutes after birth these movements have settled down into a regular respiratory rhythm. The kitten is now not only breathing, it has righted itself so as to lie in a position with its legs under it, its head resting on the floor. It then makes side-to-side movements with its head, and finally begins to crawl by paddling itself with its legs, using the forelegs freely, until it reaches the mother. In this attempt it is successful in anywhere from one minute to one hour. An average of twelve to fifteen minutes is necessary for the newborn kitten to reach the mother's body. After several trials and errors, it succeeds in attaching itself to a nipple. Its eyes are closed, and the only other means available for directing it to its destination for food is the sense of hearing and the temperature sense.

Thus at birth the kitten presents certain demonstrable components of behavior: it breathes; it rights itself; it crawls to the mother; it locates a nipple and begins to nurse.

The next stages in development carry the animal onward toward the time when all of its components have been acquired and its total stream of behavior is that of full adult life. These components, as might be expected, do not come all at once. Nor does any one of them make its appearance with distinct sharpness. Each new acquisition, adding to the reactive capacity, comes in gradually and is recognizable only when it has reached a high degree of development.

Behavior in the Newborn. The earliest reactions, such as righting, crawling to the mother and beginning to nurse, are unlearned. The animal has not yet had the experience necessary to the learning process. What it does appears to be the result of reaction-patterns inherited from a long line of vertebrate ancestors.

There is no difficulty in recognizing the necessity of these early behavior components. Without them life would be impossible in the newly established independent existence. The early components are interwoven one into the other so that they form that fabric of reaction-patterns needed to carry on life from the point where intrauterine living has ceased and the animal has been forced to assume many responsibilities in order to keep going. The kitten has had none of the opportunities for practice upon which the learning process depends; yet, immediately after delivery from the uterus, it puts into operation reactions sufficient to guarantee its own separate independent existence. With any of its primitive components missing, life is in jeopardy. These early reactions appear to be inherent and unlearned. If such be the case, they may be regarded as phyletically conditioned or inherited reaction-patterns. This interpretation of them may be disputed. On the other hand, certain performances of the newborn mammal suggest that a strong hereditary influence is at work. If, immediately after birth, the kitten, which has just begun to breathe, is placed in an ample vessel of water, it begins to swim. Its swimming movements correspond in detail to those of tetrapod reptiles; yet this mammal which is under no necessity whatsoever to swim, does so efficiently when confronted by a situation requiring swimming movements.

Such a behavior component with its full complement of paddling movements necessary to swimming, seems to have come down direct and unaltered from earlier aquatic life. If this supposition seems reasonable, what is the significance of these persistent swimming movements in a mammal which has no need of them? Their general pattern seems to correspond almost exactly to the paddling movements which the newborn kitten makes in its crawling approach to the mother. In this light there appears to have been an adaptation of an ancient aquatic formula to the needs of terrestrial life.

Maturing of the Motor Cortex. A feature of equal interest concerning these early reactions is the fact that they are well provided for in the mechanisms of that part of the brain which has been the regulator of ancient vertebrate life from its earliest beginnings. And more interesting still, that new part of the brain which has provided mostly for recent advances, the cortex, shows no preparation to contribute in the slightest way to these first phases of behavior. This means, if it means anything at all, that the most primitive unlearned reactions are administered by the most ancient

part of the brain, the brain stem, while the newest part of the brain, the cortex, has little if anything to do with them. It is not surprising, consequently, to find in the kitten at birth no evidence of maturity in the neopallium. The motor cortex at birth, especially, shows little evidence of anything approaching complete ripening. It has advanced but little beyond the stage of the kitten at 125 mm. (immediately prior to birth).

The outer zonal layer has all of the pallid appearance which it had in this previous stage. A few small cells are scattered throughout it, but in its general appearance it is thoroughly homogeneous in its entire extent. The next underlying layer constitutes a dense and conspicuous element of the cortex. The characteristic appearance of this layer has changed but little from the preceding prenatal stage. It is made up of cell cords all lying in close relation to each other, most densely compact at their outer extremities. In these cell cords the cellular elements become progressively larger toward the inner depths and the distance between the cells is likewise greater. The cells themselves are pyriform, having polar processes at right angles to the zonal layer. Each cord of cells consists of five or six cells in a row. The cells possess a large nucleus and a small nucleolus, with no evidence of tigroid bodies in their substance. The spaces between the cords of cells are irregular, and the disposition of the cords in some instances is such that there is a slight space between a cord and its immediate neighbor. The cords are all parallel and in general perpendicular to the surface of the cortex. In some instances, several cords lie close together, as many as four or five rows being in close contact without intervening space. The cytoplasm in the cells is scanty, the nucleus being the prominent portion of each cellular element.

At the internal extremity of this dense cord layer, cells belonging to it, now grown much larger in all dimensions, have wandered inward to the depths of the cortex. Other smaller cells, oval in outline, are scattered among them in the form of cell clusters, forming dense aggregations or in somewhat open aciniform arrangement. In addition to these, there are scattered irregular groups of cells and here and there single cells, all of the same general character, with large nucleus and a scant amount of cytoplasm, but no evidence of tigroid bodies in them. In this confused matrix of oval cells the larger pearshaped cells derived from the outer dense layer have taken up their positions.

At the base of the layer of irregular, clustered cells, which is of considerable depth, there appear in the motor region, particularly in the neighborhood of the sigmoid fissure, certain pearshaped cells two or three times as large as any already enumerated. They are arranged in irregular clusters and clumps, and constitute a well-marked stratum. Among these larger cells are some which appear even to exceed the others in size. Their cellular processes are clearly made out. The nucleus is large and vesicular; the nuclei are eccentric in position. These are the giant motor cells. The cytoplasm in many of them is extensive. It is granular and only in doubtful instances is there anything resembling tigroid bodies. The structural impression conveyed by the appearance of these large giant cells is in many ways similar to that created by the pathological state known as cloudy swelling in nerve cells. Scattered among the giant cells are many smaller elements.

Between the giant-cells and the intermediate zone there are clusters of medium-sized pearshaped cells, interspersed among which are smaller oval elements, separated by large spaces, which become more extensive as the base of this layer is approached. In this position there also appear numerous fusiform or spindle cells of varying dimensions, which constitute the innermost cell layer of this young cortex.

A Week After Birth. Seven days after birth there is much evidence of further ripening, but even yet the cortex seems too immature to assume fully the duties of controlling the behavior of the animal. As a matter of fact, the kitten at this stage has learned little new in the way of reactions. Its eyes are just beginning to open, but there is no indication that it actually sees, although it does respond to light stimuli.

The outer homogeneous layer of the cortex has not changed. It is, however, in the dense cell-cord layer that conspicuous modifications are apparent. The chief alteration is the decreasing density at the inner extremity of the cell cords. This is due to two important changes: (1) an increase in the size of the cells, and (2) a migration of the cells away from their original association with the cords. These migrating cells have now assumed a more thoroughly pyramidal shape. It is now possible to recognize in all of the cell cords, five or six cells in length, a more distinct pyramidal form in their outline. Cells of three different sizes have arisen from the cords: the outer small pyramidal cells still densely packed together;

the middle medium-sized pyramidal cells; and the inner large pyramidal cells further separated from each other. The larger elements have moved away to take up irregular positions in the loose layer which, as before, consists of scattered clusters and cords of cells of medium size. In none of these cells is there any evidence of tigroid bodies. All of the neural cells in the cortex are all still quite immature.

Fourteen and Twenty-one Days Old. At the end of the second week the kitten has shown but one added behavior component. It is now able to follow moving objects with its eyes and does so follow them. But its motor activities have not increased. It has shown no disposition to develop or learn new movements. Its cortex is correspondingly immature.

The changes seen at seven days in all of the layers have become somewhat more advanced, but nothing in any way suggestive of a cortex ready to take over the administration of life is yet in evidence.

This is also true of the twenty-one-day stage. All of the pyramidal cells show definite polar processes, indicating that dendritic development is now under way. The striking change is the general separation of all the cells from each other, except those which form the outermost zone in the original cell-cord layer, where here the cells adhere to their old arrangement and remain densely crowded together. This separation means that an important step has taken place in reaching maturity, namely, ingrowth and spreading of cell processes, so that, by means of their axis cylinders and then by their dendrites, they may establish essential contacts. This advance makes it possible for one layer of the cortex to act in coöperation with others. There is still no evidence, however, of any actual development of tigroid bodies in any of the nerve cells.

Forty-two Days Old. At the forty-second day of development the kitten is able to perform many acts which show the effects of learning. It is by this time able to stand, to walk, to scratch, to back away from threats to injure it; it can run in pursuit or in escape; it uses its fore- and hindpaws in play and its forepaws for washing its body; it turns its head and its ears in the direction of sound. It has partially ceased nursing and has learned to lap milk from a saucer. It can climb and jump. Many of these activities are carried on in what seems to be play; but, if aroused, the animal is capable of assuming the attitudes and activities of defense. Many of these reactions have been acquired as the result of learning, of

imitation, of playing with the mother and other members of the litter. They are all new components of behavior not inherent, but learned and conditioned by the progressive adjustment of the animal to its environment.

In proportion as these new activities have come into existence, the cortex has shown many signs of readiness to take over control of the animal's behavior. The old inherited reactions have not entirely disappeared; they have been replaced or overshadowed by others of a more conspicuous character. To provide for this advance the motor cortex has partially ripened. Many of its pyramidal cells of all sizes—small, medium, large and giant-cells—show the presence of tigroid bodies; but an even more striking development has occurred in the smaller oval cells, which now are starshaped and seem to be scattered among the other cellular elements, forming a layer between the giant pyramid cells and the pyramidal cells of medium size. Thus, at forty-two days, the motor cortex is ready to take control, in some degree at least. It has not developed its full capacities of executive power, but it is ready to operate in directing reactions which may be or have been learned.

The starshaped cells scattered among the pyramids are connectors which serve to bridge horizontally the space between one row of pyramids and the next. It thus becomes apparent that all of the active nerve elements, both of the pyramidal and of the starshaped varieties, have been derived from the primitive cell-cord layer. Amidst these active elements are scattered smaller neuroglial cells which made their first appearance as an outstreaming from the mantle layer and now constitute a matrix to support the active elements. The giant pyramid cells are large. Their Nissl bodies are distinct. The appearance is actually that of the adult. The resemblance to cloudy swelling has disappeared; the tigroid bodies are prominent, although they are not present in all of the stellate or in all of the pyramidal cells.

The Brain when Sixty Days Old. At sixty days the kitten is able to carry on still more complex activities, such as pursuit in hunting; defense against natural and recognized enemies; eating solid food, such as meat. It is on the high road to become a thoroughly independent member of its family. The cortex then shows all of those changes which might be expected of maturity, namely, a still greater separation between all of the cellular elements, indicative of the ingrowth and expansion of dendritic processes and of

axis cylinders. The original cell-cord layer in its outer portion is still dense and shows many pyramidal cells which are still in a transitional stage. The giant pyramidal layer, as well as the other pyramidal layers, have attained almost adult conditions. The giant-cells are clustered in groups as in the adult and in all of the cells are well-defined tigroid bodies. At this stage seven distinct layers of the nearly ripened cortex are distinguishable: (1) the outer zonal layer; (2) the layer of small pyramidal cells; (3) the layer of medium-sized pyramidal cells; (4) the stellate layer; (5) the giant-cell layer; (6) the inner stellate layer; and (7) the spindle or fusiform layer.

Development has thus presented a steady, progressive advance from the dense, compact, deeply staining cell-cord layer of the primitive embryonic cortex, to the matured, widely separated cellular elements with their many dendritic processes and axis cylinders ready to receive and to conduct nerve impulses.

How nearly the cat of sixty days has approached to adult conditions is easily discerned by comparison with the mature animal. The individual cell processes are more distinct, the Nissl bodies more definite. The nucleus occupies its typical central position and the dendritic processes are all more clearly visible. Add to this a greater distinctness in form and outline of the stellate cells and it is possible to perceive how maturity in the adult cortex depends upon the ultimate capacity of the individual cells to assume their full function as operating units. The introduction of capable connecting elements, such as the stellate cells, provides for the intercommunication between cells of one area and cells situated in adjacent regions.

Maturing of the Visual Cortex. Like the motor cortex, the cortical area essential to vision passes through a ripening process. The history of its progressive changes is different only in the differentiation of the several layers. The ripening process in the visual cortex is more rapid than in the motor area. Many of the critical specializations seen in the motor region at forty-two days have already occurred in the kitten twenty-one days after birth. This is particularly true with reference to the ripening of the pyramidal cells, their distribution in typical layers, and also the appearance of tigroid bodies. The stellate cells, acting as connectors at this relatively early stage of growth, have also gone to greater length in ripening than is true in the motor area. This fact points to a

functional activity of great significance, namely, that the cortex in the visual area ripens earlier so that the function of vision may minister to the needs of the animal at an earlier date than is true of motor control, that the animal may see and understand what it sees, that it may acquire the most important of its directive influences, that it may learn to distinguish and discriminate at the earliest possible moment by means of its cortical activity, in order that, through this important avenue of perception, it may select advantageous situations and avoid hazardous factors in the upbuilding of its learned behavior. To this end vision is a most important sense.

The ripening in the cortex of these two regions of the brain seems clearly to indicate that there is a structural basis to behavior. This last-acquired portion of the nervous system is the instrument of most, if not all, learning. The animal born in the wild, by learning, adjusts itself to all the needs which this type of existence demands: it forages for itself; it protects itself; it breeds and rears its young. It learns to recognize its enemies and its prey. It develops many modes of hunting strategy and many means for escaping dangers. In consequence of this learning its behavior is shaped and determined. The same species, under the circumstances of domestication, learns many different adjustments to accord with its associations with man. And still further, under special training which makes the animal a circus performer, new and far more complex activities are acquired in consequence of learning. All of this is made possible by the cortex. It is the organ of ultimate adjustment with a remarkable balance in its developmental response to the situations in which the animal finds itself.

Up to this point the maturing process has been traced in the nerve cells—those elements essential to transforming and despatching nerve impulses. Their ripening appears to be in direct relation to their activity. It is necessary for them to reach a certain degree of maturity before they are able to contribute their specific influences to the direction of behavior.

The Maturing of Nerve Fibers. Equally as important as the ripening of the nerve cells is a conspicuous process which may be observed in the nerve fibers arising from these cells. It is by means of such fibers that nerve impulses from the cells find their proper conduction. By all evidence at present available, it appears to be an established fact that the ripening of a nerve fiber depends

upon two factors: First, the outgrowth of the axis cylinder from the cell of origin to its destination. In many instances this factor by itself appears to be sufficient for the proper conduction of nerve impulses from point to point. In other instances it is apparently insufficient. The nerve fiber needs the addition of another element to make it adequate for its work of conduction. This other element serves in the capacity of an insulating substance. Two axis cylinders may lie in contact with each other unless each is more or less completely surrounded by some isolating tissue or substance. The insulating substance which surrounds the nerve fiber is called myelin. It is a complex chemical material and forms a sheath about the axis cylinder much as rubber insulation forms a sheath about the copper wire used for electricity. Some nerve fibers have scanty sheaths; but it appears to be the case that those serving for the conduction of the most highly discrete and generally important impulses possess an ample myelin covering. On the other hand, nerve fibers serving to transmit impulses which activate more indiscriminate responses often have but a meager myelin covering.

The Process of Nerve Insulation. Whether the myelin sheath is ample or scanty, this insulation of the nerve fiber is essential to proper conduction. In processes of disease, when the sheath for one reason or another is damaged or disappears, the patient begins to present the symptoms due to the improper transmission of nerve impulses. It seems to be the case that in the course of development the most adequate conduction does not occur until the nerve fiber has properly ripened by attaining its myelin insulation.

Concerning this ripening of fibers, it has long been known that different systems in the developing brain follow a definite chronological sequence. Fibers belonging to a particular functional system mature at the same time. This process may be employed as a highly valuable control of maturing in the nerve cell. It is of especial value for the light which it sheds upon the ripening of the cortex. Here it not only indicates what regional areas are first to become active; it also provides a chronological schedule according to which each successive area begins to exert its physiological influence. It likewise offers much suggestive evidence concerning the periods of development when the individual layers appear ready to assume their responsibilities.

The process of insulation in the brain stem is of equal importance.

This part of the brain exerts control over the earliest of behavior components. It is here that the first evidence of insulation appears. In many animals at birth the degree of brain-stem insulation is slight, but the number of their behavior components is correspondingly small. As time goes on and new reactions appear, the extent of myelinization increases. It may eventually be possible to read from the myelin picture of a certain species the exact stage of its behavior development. We may even expect to find the structural evidence of delayed or retarded development in myelin deficiencies.

Such possibilities reveal a vista of astonishing proportions for the future development of organic neurology. They apply directly to the problems of defective, delinquent, aberrant and imperfect behavior. This is a field in which we now speak for the most part loosely and without accredited basis in fact.

One point seems fairly established at present: the cortex of the newborn animal plays little or no active part in directing behavior. This conclusion applies to many animals. There are exceptions, however, of utmost importance.

Maturing in the nervous system of three familiar animals furnishes significant evidence in these particulars.

Behavior Differences in Animals at Birth. These animals are the cat, the rat and the guinea-pig. They manifest striking differences in their early postnatal behavior and in their maturing processes.

Immediately after birth the kitten is equipped with certain reactions competent to care for the first phases of its independent life. In addition to its visceral functions, it at once begins to breathe; it rights itself so that its legs are under its body; then it begins to crawl toward the mother and in a relatively short time is obtaining nourishment.

Totally different is the case of the rat. This animal is born as one of a large litter, usually twice the number of the feline litter. It is not only immature structurally, but it possesses little independent postnatal reaction, with the exception of respiration; it has no power to right itself, no ability to reach the mother; nearly an entire day elapses before there is evidence of milk in its stomach. The mother supplies all of the performances necessary for protection and warmth; she carefully gathers each member of the litter into a well-prepared nest.

More surprising still are the earliest reactions of the newborn

guinea-pig. This animal appears ready at once to meet the usual exigencies of life, requiring little assistance from the mother. It is prepared to get about under its own power; its eyes are open and it possesses a defense mechanism capable of fairly efficient self-protection; toward the end of the first day, although it obtains some nourishment from the mother, it is able to seek and obtain other food for itself.

The brain stems of these three animals at birth show differences in the ripening process which correspond to the differences in behavior. In the cat there is a moderate degree of myelinization. All of the nerve fibers necessary to carry on its four or five components of behavior are myelinized and ready to conduct nerve impulses. Each component of behavior may be analyzed and explained on the basis of this insulation. In the rat, born prematurely and capable of little independent reaction, there is no myelin in the brain stem. The guinea-pig, so nearly independent at birth, has extensive myelinization not alone in the brain stem but also in the end-brain. In this case the process of ripening appears to have been rushed to its conclusions. The animal when born is equipped with almost its full quota of behavior components. In the rat, birth appears to be exceedingly premature. No ripening has taken place in the brain and no provision is made for reactions. The cat occupies an intermediate position between these two extremes, and, while incomplete in all of its behavior, still has certain capacities for reaction. All of the complex activities of the guinea-pig at birth must be considered unlearned reactions. Many of these reactions require days and even weeks for the cat and the rat to attain. It is for this reason that much conservation must be exercised in distinguishing between learned and unlearned reactions. Much of their character depends upon the conditions of intraüterine life. These conditions, in turn, are reflected upon the nervous system, especially upon the brain stem, which, according to its degree of ripening, may be capable of controlling actions with a high degree of maturity, actions relatively immature, or no action at all.

This interpretation leads to an important deduction, namely, that the degree of postnatal reactive control, as well as the progressive accessions to it, bear a direct relation to the insulating process in the nervous system. The details of this process, from stage to stage, in the cat are of extreme interest. They show a distinct parallelism in the expansion of behavior and in myelinization.

From the studies already made there can be little doubt that these two processes go hand in hand.

Special Postnatal Needs in Locomotion. Immediately after birth the kitten begins its independent career. All mechanisms for breathing and circulating the blood are established and have acquired their automatic regularity. Such is not the case with those acquisitive reactions essential to maintain metabolism. The animal must seek, find and utilize a reliable source of food. It must have warmth from a source of heat outside of its own body. At once it begins to manifest adequate reactions which up to this time it has not shown. The first of these is to place its body in a proper relation to the surface of the earth under the influence of gravity. To lie upon its back or to remain recumbent upon its side would make further independent progress impossible. Its first act, therefore, is to obtain a proper position so that it may use its locomotive mechanisms advantageously. Implicit in this act is the necessity of maintaining this position once it has been assumed, and to reëstablish it whenever it is overthrown. This position may properly be called the optimum physiological posture. Without this position the animal could not do its physiological best. It would not be able to stand or walk in the four-legged manner, to run or climb; in a word, to perform any of those acts upon which the life of every quadruped depends. Fortunately for the newborn kitten, its needs in locomotion are extremely simple. It has but short distances to traverse in its early scheme of existence, but these distances are vital. From the place in which it is deposited at birth, it is not more than a few inches to the mother's body; but this space must be traveled by the kitten itself. No maternal assistance is given in this act. Consequently, when the animal has assumed the optimum physiological position, with its chin, chest and abdomen resting upon the supporting surface, with its legs sprawled out on either side beneath it, it has taken the first great step essential to locomotion. Almost immediately its head begins to move from side to side and then the paws are moved rhythmically backward and forward. Each forepaw is extended and then drawn backward in a sort of paddling movement, in this way moving the animal's body slowly forward. In these paddling movements the hindlegs participate, but to a less degree. They are slowly flexed and then extended, alternating with each other, with less rhythm than is true of the forepaws. Employing this type of locomotion, the newborn kitten reaches the

mother's body in an average of twelve to fifteen minutes. A few minutes later it has secured a nipple and is nursing. In some instances this approach reaction to the mother is much delayed, consuming an hour or more in its performance; in other instances the animal reaches the mother in a minute or two.

Similarities to Reptilian Locomotion. In these movements of the approach reaction there is something suggestive of certain reptilian locomotion upon land. In general pattern they resemble those movements seen in the alligators, lizards and turtles. The movements of the limbs are slow and rhythmical, but do not lift the body far from the ground. The legs are bent and have none of that full extension which eventually gives most mammals the capacity of traveling with some degree of speed over the surface of the earth. These paddling movements on land, characteristic of the alligator and turtle, at once become powerful and rapid when these animals are in the water. The paddling movements of the newborn kitten are distinctly reminiscent of the land movements of many reptiles. With the kitten as with the reptile there is a transformation from awkwardness to grace when the animal is forced to swim. This similarity may be regarded as indicative of definitely phylogenetic influences. It clearly suggests the hereditary antiquity of the swimming pattern in most mammals.

Reflex Mechanisms for Early Behavior. The somatic behavior of the kitten at birth comprises: (1) the posture reaction; (2) the approaching reaction; (3) the sucking reaction. The brain at birth is prepared to receive the proper stimuli and to produce the necessary responses for such performances. The more exact analysis in each of these reactions I made in collaboration with Dr. Casamajor some years ago. It may suffice to say here that it was possible to explain in terms of operating nerve centers and ripened nerve fibers the structural mechanism necessary to each of these early components of behavior. It is our opinion that the reflex arcs ready to operate at the time of birth are sufficient to carry the nerve power essential to the earliest reactions. We are not alone in this belief. More recent work by Langworthy, also upon the kitten, has led to closely similar conclusions. Langworthy investigated the myelinization of the central nervous system of young kittens, attempting to correlate the behavior of these animals with a function of definitive myelinated reflex arcs. He concludes that pathways appear to become myelinated in the order in which they develop phylo-

genetically. He also cites many illustrations in the correlation of reflex activity with myelinization in the nervous system. Langworthy differs with our original interpretation in believing that many primitive yet complex performances, like the crawling approach reaction, require only functional activities of the spinal cord. We still hold to our original view, feeling, however, that subsequent experiments may afford reason to change our present opinion. Where we are apparently at one with Langworthy is in the conclusion that none of the highest levels of the brain is sufficiently mature at birth to control early behavior. The brain stem and the spinal cord must, therefore, be regarded as adequate for the earliest reaction patterns. The cortex (particularly the neopallium) plays little if any rôle in this capacity.

The acquisition of new components in the kitten is relatively slow, much slower, for example, than in the rat. But successively, and usually one or two at a time, new reaction-patterns make their appearance. These additions increase the capacity of the kitten to make more ample adjustments to its environment. The synergizing reaction appears on the seventh day. It then becomes possible for the kitten to hold its head with greater steadiness. Up to this time the head movements have been ataxic and uncertain. This ataxia is in marked contrast to the conditions observed in nesting birds (wren, dove, pigeon, canary). In them the head movements are fully coördinated from the moment of hatching. Such a reaction pattern is necessary to their feeding process. Were the nesting bird's head, after hatching, as unsteady as that of the cat, there would be an obstacle to the bill-to-bill feeding between parent and young. But the reflex system in the brain has already matured in the bird. The corresponding system only begins to make itself apparent and is partially matured at the end of seven days in the cat. On the seventh day, also, the primitive escape reaction appears. This is a definite avoiding reaction, manifesting itself in new and more highly systematized movements by means of which the animal escapes from painful stimuli. During the first week the young kitten utilizes a seemingly diffuse mechanism to avoid painful stimulation. On the seventh day the animal moves away from the source of such stimulation toward which it turns its head and to which it directs its eyes. This reaction is regarded as a behavioral component which in all probability serves as the substratum for more complex escaping and avoiding reactions in later periods of develop-

ment. Such advance is based upon the maturing of sensory fibers conveying impressions from the body surfaces, as well as a ripening of the fibers provided to conduct visual impressions. On the seventh day, also, the kitten opens its eyes and for the first time begins to utilize light transmitted directly through the optic structures. In connection with this specialization, myelinization of the optic fibers is now apparent. At birth there was no insulation of the visual fibers.

Accessions to Behavior. At the second week the eye and head-turning reaction appears, thus making visual pursuit possible. On the twentieth day the sitting reaction appears; the walking reaction on the twenty-second day; the scratching reaction on the twenty-third; the backing-away avoiding reaction on the twenty-fifth day. The running reaction in pursuit or escape appears on the twenty-sixth day, as do, also, the pawing reaction with the forepaws in play and the washing reaction with the forepaws to the face. The auditional head- and ear-turning reaction in response to sounds appears on the twenty-sixth day, the lapping reaction in drinking milk from a saucer on the twenty-ninth day and the escape defense reaction on the twenty-ninth day; the climbing reaction appears on the thirty-first day.

This schedule in development is based on the observation of several hundred kittens. It is possible that this number is insufficient to permit of a final and exact time scheduling of the different reactions. In subsequent periods other reactions are acquired which bring the animal up to its full behavioral stature. These actions include such performances as burying of dejecta, independent procuring of food, hunting and pursuit of prey, defense and attack adjustments and sexual activity. Most of these, however, are variable in their time of appearance and have less chronological uniformity than is true of the earlier performances. They are, for the most part, to be regarded as learned reactions and consequently subject to variations in the conditioning process.

Up to this time it has been possible to correlate the appearance of early behavior components with maturing in the nervous system as far as the fourteenth day. Beyond this point the problem becomes much more complex, although there is reason to believe that by more improved methods this correlation may be carried forward into the late stages of development, up to the final stage of maturity. The elements maturing in the cortex of the end-brain

are far behind those in the brain stem. In the cat the cortex does not reach that degree of maturity considered sufficient for proper functioning earlier than the twenty-first day. Only shortly before this time does the cat begin to manifest those reactions which belong to the learned variety. Prior to this period its activities depend upon the spinal cord and brain stem as far cephalad as the midbrain; thereafter the cortex begins to assume dominance in the control of behavior. Many of those reactions which appear in the earliest stages of life are adapted and readjusted to a higher control. It is probable that they are not lost, but simply incorporated as parts of more complex and more efficient behavior components. In this light a hard-and-fast boundary between learned and unlearned reaction becomes all the more improbable. On the other hand, it is certain that the lower levels of the axis, including the spinal cord and brain stem, assume authority over the earliest activities of life. These portions of the nervous system bring forward from the past all of the vital controlling mechanisms. They are distinctly limited in their capacity for extensive conditioning, and thus at the time when such conditioning is imperative the major control of behavior is transferred to the cerebral cortex. This is the portion of the brain which has provided the possibilities of progress and which, while it has consistently kept future developments in sight, employs to the greatest advantage the mechanisms of the past in meeting the conditions of the present.

Maturing of the Rat. The detailed history of myelin maturing in the rat is strikingly different from that of the cat. At birth there is no evidence of myelin in the entire brain stem or in the hemispheres. The ripening process from this point proceeds somewhat more rapidly than in the cat. There is some early hesitation in the maturing of the brain, as there is also slowness in the development of the behavior components in the rat; but by the sixteenth day the myelinization in the brain stem of the rat is far in advance of that of the cat of twenty-eight days. Myelin is also in evidence in the cortex. The cortex itself has shown those remarkable advances in the character and arrangement of its cells which indicate the near approach of its functional activity.

Time will not permit the exact analysis of the various fiber systems which have developed in the several divisions of the brain stem, the basal ganglia and the cerebral cortex. It may be said, in summary, that the stage of ripening in the rat of sixteen days pro-

vides a nervous system capable of carrying on the reactions of an animal much more matured in its behavior than the cat a month old. Thus the ripening process in this rodent toward its end proceeds more rapidly than in the cat. The rat in consequence reaches its individual independence as a reacting organism at an earlier date.

While the explanation of this maturity in behavior may be read in the nervous system, the causes explaining it are by no means apparent. They must be vested in the extremely complex condition of the animal's environment and the necessity imposed by that environment upon the animal to maintain itself at an early moment.

There is another factor entering into the rapid maturing in the rat. The limited *repertoire* of the animal's adult performances, the narrow stream of its behavior reactions, do not call upon it for an extensive mechanism or a highly intricate system of neural connections to manage its relatively simple life. Many facts support the idea that a longer period of maturing favors the development of a more complex and hence a more capable controlling mechanism in the brain. Thus it is that the cat and most of the carnivores—together with the primates, especially those of the higher families, and, last of all, man—pass through a long period of ripening before the brain is sufficiently mature to meet the requirements of correspondingly complex types of behavior.

At twenty-four days all of the major systems in the brain stem and in the cerebral hemispheres are myelinized in the rat. Many of the systems have attained their full degree of myelinization. Some of those representing the highest degree of organization in behavior, such as the cortical control of motion, are not so intensely myelinized as in the adult. On the other hand, all of the great sensory and coördinating systems are approximately adult. The cortex, also, is nearly adult in its development.

At thirty days after birth the myelinization in the brain stem of the rat has attained adult completeness. It is almost impossible to detect any difference in any part of the nervous system between the animal at this age and the adult. The young rat, to all intents and purposes, with the possible exception of maturity in sexual function, has reached its adult status. Its cerebral cortex, both in cells and in fibers, is mature and capable of carrying on the functions regulated by this part of the nervous system. In many respects the kitten sixty-two days of age is more immature than the rat of thirty days. This immaturity shows itself not only in the partial

myelinization of many of the great projection systems—such as the corticospinal, spinothalamic and mesial fillet—but in the still imperfect development of the cortex both in its cellular and in its fiber constituents. Many important components of behavior in the cat have not yet made their appearance, such as full hunting activities and other performances dependent upon imitation and learning for their development.

Maturing in the Guinea-pig. The development of the guinea-pig is in marked contrast to the rat. This animal has a brain stem which immediately after birth appears to be completely myelinized. Each one of the great systems for converting adequate somatic stimuli into corresponding somatic responses has received its full complement of myelin. This condition obtains throughout the entire brain stem. The degree of ripening provides for a full complement of reactions regulated by this part of the brain. When compared with the adult brain the maturing process in the cortex is but little less advanced. Both cells and fibers are in such ripe condition that they are capable of regulating all of those elements essential to cortical control. It is of physiological interest that, beyond acquiring greater size, more strength and definite sex behavior, the guinea-pig at birth differs but little from the adult of its species.

The Cerebral Cortex in Relation to Learned Reactions. The conditions in the guinea-pig clearly indicate a distinction of much biological importance. Attention has already been called to the fact that the cortex of the mammal is in the main concerned with the acquisition and regulation of learned reactions; that is to say, that type of behavior which depends upon long experience with environmental conditions, with the repeated approach of the same or similar stimuli and with the more or less definite formulation of the same or similar responses in consequence of such stimuli. This viewpoint in its broad applications cannot be denied. But the case of such animals as the guinea-pig, with a cortex development at birth closely approximating adult conditions, clearly indicates that the mammalian neopallium is not exclusively devoted to the acquisition of learned reactions. It may, and apparently does, participate in the control of certain activities which neither stimulus nor experience has yet permitted to enter the class of learned behavior. This possibility illustrates the remarkable plasticity of the cortex, and at the same time makes clear that there is no abrupt transition from

the unlearned to the learned reaction, that the usual distinction between these two is probably too dogmatically drawn and that the unlearned reaction may serve as the basis and starting point for a greatly expanded range of learned behavior. It is, therefore, the further development of the mammalian cortex, the addition to it of those high levels and platforms of elaboration so brilliantly suggested by Orton, that is connected with those farthest advances in behavioral perfection which we choose to call learned reactions. Among these there must be all degrees of elaboration, from those most simple in their structural pattern to those of greatest complexity. If the conditions of maturing in the guinea-pig's cerebral cortex at birth are accepted as a criterion, then we must admit that the cortical structure has all of the phases of graded transition which may be witnessed in behavior in passing from unlearned to learned reactions. While, therefore, it is true that the headquarters of primitive unlearned reaction is in the brain stem, it is equally certain that the cortex is engaged in activities of this kind as well. It may be less clear that the high degree of conditioning affecting the cortical structures in the course of developing more elaborate types of behavior, can also affect the brain stem. Nevertheless, such evidence as is available does make it seem probable that, to some degree at least, conditioning does alter the activity of behavior reactions administered through the brain stem. This again points to the fact already noted, that there is a transition rather than a sharp line of demarcation between learned and unlearned behavior. The inherent control of the brain stem and the progressive development in behavior patterns dependent upon it may be seen in those animals not possessed of a neopallium.

Behavior of the Newly-hatched Pigeon. A good illustration of this kind is seen in the homing pigeon which, immediately after hatching, presents several of the behavior components characteristic of the newborn kitten. The similarity between the myelinization in its brain at this stage is so striking as to make the microscopic distinction between the mammal and the bird somewhat difficult. Only close examination reveals the differences in the myelin patterns. Many pigeons, immediately upon leaving the egg, essentially without feathers, have the power of righting themselves. Their efforts in this direction are somewhat feebler than those of the kitten. Some individuals immediately after hatching are not able to carry out this action. In almost every instance the pigeon, put upon a flat,

smooth surface and stimulated with a straw or other pointed implement, will make efforts to crawl, using the legs and the wings in much the same manner as the paddling movements of the new-born kitten. Immediately upon leaving the egg, the pigeon assumes a position with the legs flexed beneath it and its body resting on the abdomino-thoracic surface. The wings are folded into the body and the animal remains motionless.

In one important detail the behavior of the pigeon at this stage differs from the cat. It holds its head erect, steady and well coördinated. The contrast with the kitten in this particular is pronounced. In the latter animal the head movements are incoordinated and unsteady, and remain so for a considerable period. This difference between the bird and the mammal is significant. It is interwoven with and an essential part of the feeding behavior. The eyes are closed; but the moment the region of the bill is stimulated in the bird, the mouth is opened widely, the tongue depressed and the head thrust forward. Meanwhile, the muscles of the neck are so well coördinated as to hold the head steady. This reaction is necessary for feeding, the stimulus being the approach of the parent bird with food in the beak and the thrusting of the beak into the open mouth of the offspring. Unsteady movements in the act of holding the head erect would interfere with the proper transmission of food from parent to young.

This essential difference in behavior is reflected in the stage of myelinization seen in the bird on hatching. This animal is fully equipped with myelinized fibers communicating with the cerebellum to provide it with steady coördinated movements of the head. The entire circumferential zone of the stem containing the afferent cerebellar pathways is completely myelinized. Myelinization is also present in the cerebellum itself. These fibers may be traced from the lateral aspect of the stem and observed streaming inward to enter the middle portion of the cerebellum, where they undergo decussation and apparently communicate with three lateral folia immediately superior to the dorsal aspect of the stem. Some myelinization appears also in the lobus posterior of the cerebellum.

The chief myelinization at this stage consists, as in the cat, of the posterior longitudinal fasciculus and the predorsal bundle, the crossed and uncrossed portions of the deiterso-spinal tract, the descending trigeminal and the cerebellar tracts. The cranial nerve fibers myelinized are the twelfth to the tongue, the tenth, the ninth

and both divisions of the acoustic. On the basis of this myelinization it is possible to explain all that the pigeon does upon leaving the shell. This consists of holding itself in the correct sitting posture in the nest, of holding its head erect, of opening its mouth to receive food, of seizing and swallowing its food. There is no evidence of myelinization in the cephalic portions of the cerebellum corresponding to the lobus anterior. The cerebellar cortex is still not differentiated and must, therefore, be considered immature. It has not ripened sufficiently to carry on full cerebellar function. The posterior longitudinal fasciculus and predorsal bundles are both well myelinized. The third and sixth nerves show strong myelinization. The cortex of the lobus opticus is still in an immature state and has many appearances resembling the immature cortex of the cerebral hemisphere in the mammal. No myelinized fibers are seen either approaching or leaving the cortex of the optic lobe at this stage. This is consonant with the fact that the bird at birth is not possessed of visual activity. The posterior longitudinal fasciculus and predorsal bundle may be traced as far cephalad as the middle of the oculomotor nucleus. The fibers at this point are seen spreading out into the collicular region, but none of them is in relation with the cortex of the optic lobe. No myelinized fibers in the stem may be traced further forward than the anterior limit of the third nerve nucleus. The optic chiasm at this time is entirely without myelinized fibers and this is in direct relation to the visual capacity of the bird at this stage, in which the eyelids are closed and no vision is possible except for such light impressions as may pass through the upper lids. There is also no evidence of myelinization in the optic nerve or optic tract.

The behavioral components of the homing pigeon at birth may be accounted for on the basis of those myelinized systems of fibers already present at that time.

Eight Days After Hatching. At eight days the eyes of the bird are open; it turns its head in response both to visual and auditory stimuli. While it has made but slight advances, it has progressed to the point where it makes better accommodation in holding its position in the nest, in responding to the approach and departure of the parent bird and in making certain efforts at exploration with its head within the nest. Myelinization of the brain stem is far advanced and most of its essential fiber systems are myelinized. There are still deficiencies in the basal bundle by

means of which impulses are transmitted to the centers controlling the wings and legs. The optic nerve, chiasm and tract show a degree of myelinization, especially in the innermost fibers, which may be traced along the outer margin of the optic lobe. Only a slight degree of myelinization extends beyond the midbrain into the thalamic and striatal regions.

As compared with the adult bird, in which all the reaction patterns necessary to flying, walking, independent feeding, mating, alighting and perching have appeared, the eight-day pigeon shows an inferiority in those systems connected with the operation and coördination of the wings and legs. It is also much less developed in the afferent systems necessary for the conduction of sensory stimuli from the surface of the body. The degree of myelinization in the optic nerve and tract, as well as in the optic fibers entering the visual cortex, is far less advanced at eight days than in the adult.

Advances After Two Weeks' Development. Fourteen days after hatching the bird has progressed to a point in its behavior where notable changes have occurred. All of its pin feathers have developed, though many of the feathers in the wings are not yet complete. The animal has left the nest and is able to walk about on the floor of the cage or on the nest board. It has not yet made any attempt at flying, although it does flap its wings. It now uses both wings synchronously, having lost that peculiar activity seen when the wings are used simultaneously with the legs immediately after hatching. The alternate moving of first one wing and then the other, in combination with the legs, has in these early movements all the appearance of the paddling motions in the crawling-approach reaction of the mammal. The pigeon of fourteen days is able to stand up and walk about in a perfectly balanced way; there is no sign of ataxia or incoördination in any of its movements. It exhibits the backward and forward nodding of the head in walking characteristic of the adult bird and is able to shift for itself in so far as it only incidentally depends upon the parent bird for feeding. As a matter of fact, having detached itself from the nest it has likewise detached itself largely from the interest of the parent. It rests at night on the nest board and maintains itself in a perching posture.

To meet the requirements of these new components of behavior, a decisive advance is seen in the myelinization at this stage. The deposit of myelin upon the nerve fibers in the cerebellum approximates the degree seen in the adult. All portions of the posterior

and anterior lobes show fibers in the medullary cores of all the folia, as well as radial fibers extending into the cortex. The cells of Purkinje have taken their position and the layers of the cerebellar cortex are distinct in all their details. There is marked increase in the posterior longitudinal fasciculus and the predorsal bundles. The animal shows extensive myelinization throughout the thalamic and striatal regions. The optic nerve and tract are myelinized extensively, almost to the same degree as in the adult. The deficiencies of myelin appear particularly in the epistriatum and higher levels of the end-brain.

Behavior at the Beginning of the Flying Stage. The twenty-two-day stage of the pigeon represents the initiation of a most important advance. The bird now is able to fly. It can take off from the ground and from the perch, and if thrown into the air rapidly adjusts itself, spreading its wings and quickly coming to the ground or some other appropriate resting place. It walks about as the adult bird. It is fully feathered in wings and body. It preens itself as does the adult and in every respect has attained what appears to be a mature stage. The brain is correspondingly mature in its insulation. All of the great tracts, especially to the cerebellum in its two divisions, the anterior and posterior lobes, are fully myelinized. The radial fibers from the core bundles into the cortex of the cerebellum resemble those of the adult bird. The myelinization in the optic lobe, the diencephalon and the end-brain corresponds in detail to the later stages of development. There is, perhaps, some inferiority of myelinization in the epistriatal region.

Thus the critical stages in the development of the bird illustrate in the same way as do the stages in the mammal the progressive acquisition of behavior components, and it may be concluded that the avian and the mammalian brain in this respect are identical.

Behavior of the Newly-hatched Chick. The contrast between the pigeon immediately after hatching and the chick at the same period is another striking illustration of difference in the maturing process. In the chick all of the cerebellar regions show marked development far advanced toward adult conditions. This animal, upon leaving the shell, is able to run about, shift for itself and perform in an immature way all acts of the adult with the exception of perching and more extensive wing movements. The optic nerve is almost completely myelinized. The fibers may be traced to the cortex of the optic lobes, which show an advanced stage

of the ripening process. Myelinization may be traced far forward in the region of the thalamus and the striatal structures.

Experimental Stimulation of the Brain. In the cat certain regions of the cortex were electrically stimulated with the purpose of testing the responses obtained at various stages of development up to forty-two days of postnatal growth. Similar stimulation was applied at the optico-collicular level, at the level of the anterior colliculus, at the level of the posterior colliculus and at the levels of the upper segments in the spinal cord. These experiments produced results which are suggestive and in certain ways confirm the correlation already established between behavior and the maturing process.

Stimulation of the motor cortex of the kitten immediately before birth (125 mm. long), with the coil of the inductorium set at 6, produces flexion followed by extension of the opposite forelimb. It is difficult to say, however, whether this was the result of stimulation, as the kitten moved in the same manner without it. The same test repeated on a number of different animals of the same age showed that in the region of the cruciate fissure on the left no result was obtained, although stimulation on the right occasionally gave slow extension of the left forelimb. These responses were sufficiently inconclusive to question the excitability of the brain to artificial stimuli at this prenatal stage.

The kitten at birth, as the result of strong stimulation, showed some movement. The foot was brought forward and then back. The first motion was the typical reaching effort of paddling, and the second—drawing the paw backward—that of advancing the body. True cortical excitability at this time seemed somewhat doubtful. The hindlegs were not affected by stimulation. This result was observed in a number of young animals at this stage.

At seven days, with the coil at 8, no movement occurred upon stimulation. On repeated applications, however, there was some movement of the opposite forepaw. With increase of the current strength, active response occurred on the opposite side of the body, followed by movements of all the limbs. As in the case of the earliest stage, the type of movement was extension so that the foot was brought forward in the reaching motion and then brought back in the progressing movement.

Definite Contralateral Responses at Fourteen Days. At fourteen days the animal showed movement on the opposite side to

strong stimulation, which involved both fore- and hindlimbs. Up to this time no movement had been observed in the hindlimbs. These movements could be obtained separately or, with stronger stimulation, both together. They were prompt in their response and consisted of extension followed by flexion of the opposite forelimb. Stimulation close to the median line along the cruciate fissure gave no response. Moving the electrode laterally brought out extension of the forelimb. This was frequently repeated on different animals with the same results. It thus becomes apparent that, from a period shortly before birth up to the fourteenth day, the mechanisms for the conduction of artificial stimulation by electricity through the brain have progressively improved. Not only is there a greater degree of certainty in response, but the responses have gradually assumed the typical character of contralateral cortex innervation. This condition is consonant with the progressive ripening both in the nerve cells and in the nerve fibers.

At twenty-one days this reaction becomes still more definite. Stimulation of the motor cortex produces decisive movement in the fore- and hindlimbs of the opposite side. The movements are alternating flexion and extension, mostly in the distal joints, and all of the joints together manifest combinations in motion essential to walking. Some other indefinite movements are also produced, but those described predominate and are especially pronounced in the distal joints.

At forty-two days movement of the opposite hindfoot may be produced separately. Flexion and extension of the contralateral fore- and hindfoot, with all characteristic features of locomotive activity, are seen.

The responses obtained from the motor cortex at these different stages of development indicate that there is an increasing facility for the transmission of artificial stimulation through the cortex. There is also a progressive approximation to the results obtained from stimulation in the adult animal. These facts appear to corroborate the observations already made by other methods. They agree in detail with the cellular maturing of the cortex, as well as with the fiber maturing in the conducting processes.

Stimulation of Brain-stem Levels. Stimulation of the cat's brain below the level of the cortex, upon the surface exposed by a section in a plane passing from the anterior extremity of the superior colliculus through the optic chiasm, gives vigorous movements

without much discrimination as to parts involved in the limbs of both sides. The same is true of the section plane through the anterior colliculus at all stages of development. The movements produced are for the most part tonic and in extension. At a plane through the level of the posterior colliculus the movements are also generalized, very strong and mostly tonic. The only difference from stage to stage is the increasing force of the muscular contraction. Stimulation of the spinal cord gives no localizing effect, produces movements, largely of extension, which are generalized and tonic. In the twenty-one-day cat, in addition to limb and body movements, a deep respiratory reaction was also observed. After decerebration, without stimulation, the kitten at birth showed no decerebrate rigidity after thirty minutes. In the seven-day kitten no decerebrate rigidity was present, but gasping respiration after nine minutes did occur. The kitten of fourteen days showed no rigidity in one and three-quarter hours. In the twenty-one-day kitten decerebrate rigidity was doubtful during the entire period that the animal remained alive.

Stimulation of the cerebral cortex not only shows selective distribution to the contralateral side of the body, but singles out the forelimb first, and only in the later stages of development includes the hindlimb. This progressive selective elaboration is also shown in the fact that at first the entire limb is moved, while later discrete movements in the distal joints appear. Even more notable is the selective character and pattern-reaction when, from the third week of postnatal life onward, the movements of the legs resemble those employed in walking. Stimulation at levels below the cortex shows a wide diffusion and little or no selective response either in the type of muscular contraction or in the parts moved by the muscles. Such facts as these seem to confirm experimentally the ripening process in the cerebral cortex, especially as it affects the motor area and its projection system.

Conclusions. By demonstrating a definite structural basis for behavior, not merely in the form of the entire body but equally as much in the intimate structure of the brain, an important responsibility has been laid upon behaviorism. It is no longer sufficient to observe the manner in which behavior presents itself objectively; nor will it suffice to reveal the reasons underlying the relation of one reaction-pattern to another. Not until we have clear understandings of the mechanisms upon which these reactions depend will

there be a thoroughly satisfactory interpretation of why we behave as we do.

It is quite proper for the behaviorist to refuse longer to accept mere diagrams from neurology in explaining neural activities. There may be existing reasons why he should more willingly turn to physiology and endocrinology for further light upon his subject. Yet neither of these, separately or together, can establish an ultimately sound foundation for behaviorism or for psychology as a whole.

Exact and full knowledge concerning the structural nature of the mechanism upon which behavior depends is a prime essential. It is clearly the duty of neurology in this connection to dissociate itself from further schematization. What it owes to its sister science is the most minute and thoroughgoing revelation of all the neural elements entering into and indispensable for the upbuilding of behavior. This is no light task. To analyze the structural complexity of the nervous system, and especially of the brain, considered in its dynamic aspects as related to the development of behavior, is an undertaking which challenges the most unflinching courage. Undoubtedly the disappointments arising from such efforts in the past have rendered the service which was expected far from complete.

The program now envisages not merely the revelation of structure, but the definite relation of structure to performance. It has a practical as well as a technical purpose. While it recognizes the factors in and the products of conditioning the brain, it maintains that the brain capacity to respond to such conditioning is of equal importance. Through all that process during which nerve cells and fibers ripen, and while they are establishing their uncounted connections and interconnections, many physical and chemical factors are at work which may impede or prevent the most effective neural associations. These forces may be operative in the prenatal and early postnatal periods.

It is possible that many unfavorable factors in this process of development may be modified or thwarted. It is, likewise, possible that other more favorable factors may be activated and accentuated. To this field particularly the attempt at further understanding of the brain now turns its attention.

Many of the delinquencies in human behavior, many of its degenerative tendencies, perversions and maladjustments, may have their origin in definite structural infirmities resulting from a develop-

mental process which has been deflected out of its normal course. It is, also, believed that the normal process of maturing in the brain may be facilitated by means arising from a still better knowledge of this process.

Such a point of view has significance not merely for the behaviorist in the limited sense, but for the psychologist as well. It stresses the necessity of fully understanding the machine before attempting to interpret, manage or correct its performance.

During all this notable centenary occasion our thoughts have centered about a great and beloved representative of American achievement. Each one of us has felt the desire to do him honor, to express a deep sense of appreciation. May it be my privilege to dedicate this, and whatever further study of behavior I may have opportunity to make, to the memory of S. Weir Mitchell.

THE SURGEON AND CANCER*

The Mütter Lecture

By ROBERT B. GREENOUGH, M.D.
BOSTON

May I be permitted, first, to thank you for the honor you have conferred upon me, by the acceptance of my services to deliver the Mütter lecture. I am deeply grateful to have been selected, and I can only wish that I might do justice to the occasion by the announcement of some epochmaking discovery in regard to cancer, such as might be expected shortly to solve the problem. Unfortunately, no such discovery has yet been made, and I must content myself with a brief discussion of the more important advances in our knowledge of cancer which can be recorded, and of the methods by which those advances can be turned to practical use in the treatment of the actual cancer patient.

In spite of years of diligent and worldwide research the actual cause of cancer still remains a mystery. We must not forget, however, that many facts about cancer *have* been established during this period—some of a negative, others of a more definite and positive character—which make it possible for us to state that we now know much more about cancer than we ever did before. The theory, for instance, that cancer is a disease of parasitic origin has been almost entirely discarded. In the face of the fact that cancer can be produced experimentally in animals and accidentally in man by any one of three different types of agents—chemical (tar), physical (*x*-ray) and biological (infestation with different animal parasites)—it is difficult to maintain the necessity for a specific microörganism. Furthermore, the existence of a constitutional state, whether due to heredity or to some unknown factor in the body chemistry, sufficient to be regarded as of major significance in the etiology of cancer, is not supported by the fact that cancer can be produced in animals at will by the employment of these

* Read December 4, 1929.

three different agents above referred to. It must, of course, be admitted that, even though not a major factor, such a constitutional state may indeed exist as a matter of predisposition, such as may be operative in determining the more ready development of cancer in one individual than in another. Such an admission, however, virtually removes the constitutional condition from consideration as a major cause of the disease.

As a matter of fact, the one common factor to be detected in the three agents—physical, chemical and biological—which are capable of producing experimental cancer, is that each of them is capable of producing damage to the living cells exposed to their action of such a nature as to call forth that most important biological function, the process of repair. It is to be remembered, also, that both in man and in animals a very long continuance of these processes is required, during which a marked acceleration of growth of the affected cells is evidenced, before the so-called "precancerous stage" is passed and actual infiltrating and metastasizing cancer is produced. These conditions are often referred to as "chronic irritation," and in the precancerous stage this is perhaps as accurate a description of the clinical appearance as any that could be given; but it is the steadily augmenting energy toward growth, which is evidenced by succeeding generations of tissue cells, combined frequently with some disorder of function, which is the essential feature of the progressive process by which cells hitherto normal in their growth and function undergo the transformation into cancer cells, endowed with super-reproductive power and diminished functional differentiation.

The Cohnheim theory, which predicates the existence of embryonic rests of tissue as the starting-point of cancer, while applicable to a relatively small group of tumors, especially those of the internal organs, proves inadequate as an explanation of experimental cancer where the location of the disease is invariably at that point where the cancer-producing damage to the tissues is applied, and is equally unsatisfactory as an explanation of the more common forms of human cancer which develop in the later years of life, after varying periods of precancerous changes, such as cancer of the mouth and cancer of the uterine cervix.

In view of these considerations we may, I think, conclude that a simple parasitic cause for cancer is at least improbable; that the influence of a constitutional condition, whether inherited or acquired,

is limited at most to a degree of predisposition to cancer which cannot, so far as we know at present, be regarded as of serious significance in human beings; and that the actual production of cancer in animals and in human beings is usually brought about by long-continued and repeated damage to the tissues by any one of several different agents which are capable of calling forth in the cells adjacent or exposed to this damaging influence a continued process of increased cell reproduction, combined with a disturbance of cell function, throughout successive generation of tissue cells, up to the point where the line of independent growth is passed and infiltrating and metastasizing cancer is produced.

The tumor pathologist today recognizes with the microscope a whole series of proliferative phenomena among the so-called precancerous conditions. The criterion generally accepted by pathologists for the diagnosis of actual cancer, and in our present state of knowledge probably the *only* safe criterion, is the presence of infiltration or metastasis; in other words, the penetration of a basement membrane and the presence of cancer cells in situations within the adjacent tissues in which normal cells of the same origin are never found. It is true that there are morphological differences between the cancer cell and its progenitor, the normal cell, of the same tissue; but a diagnosis of cancer based upon these differences is not generally accepted as conclusive unless infiltration is actually demonstrated. Recently the fact has been well established that physiological differences can also be recognized between the cancer cell and normal tissues, in that cancer cells have been shown to possess the function of anaërobic glycolysis to an extent unequalled by normal cells and approached only by embryonic tissues.

This discovery of Warburg opens wide a door for further investigation, and has already suggested methods of treatment which are still in the very experimental stage. It must be regarded as an important step in the advance of our knowledge of cancer, but one the full value of which is as yet undetermined.

In the field of surgical pathology of tumors there have been interesting developments in the past few years in the attempts which have been made to determine the degree of malignancy, and the degree of radiosensitivity of tumors, by study of their histology.

We are indebted to Broders, of the Mayo Clinic, for the development of the classification of malignancy, although the facts upon which the classification is based have been well recognized in the

pathological laboratory for many years. Briefly, the matter depends upon the fact that, in cancer, loss of differentiation for function goes hand-in-hand with increased rapidity of growth and increased malignancy. This was first demonstrated in cases of squamous-cell cancer of the skin. In such cases cell function consists essentially in keratin formation, and the more evidence of keratin formation, as by the production of epithelial pearls, the less the malignancy of the tumor; whereas the undifferentiated cell, with little or no tendency to keratin formation and with all its energies devoted to rapid growth, is highly malignant. Broders checked the degree of malignancy, estimated from the histology of the original tumor, with the end-results of treatment, and they were found to correspond. Simmons promptly confirmed Broders' figures in another series of cases, and similar studies of cancer in other regions have been found in general to bear out these observations.

I have myself been interested in applying this principle to cancer of the breast, but here different criteria are needed, as the function of the breast epithelium is expressed by secretion. In breast cancer we are obliged, therefore, to consider, first, the cellular architecture of the tumor, that is, the propensity of the cells to arrange themselves in gland formation around an open lumen. Such a tendency, of course, indicates a considerable degree of differentiation, which is further demonstrated by the presence of mucinous droplets of secretion within the cell protoplasm. The fact that colloid carcinoma and adenocarcinoma are of relatively low-grade malignancy as compared to scirrhus and medullary carcinoma of the breast is, of course, familiar to you and illustrates the practical working of this principle. As the tendency to gland formation and secretion is lost, the malignancy of the tumor increases, until we have, as in a small percentage of all breast cancers, infiltrating masses of rapidly growing, undifferentiated cells, varying in size and shape, with irregular, often hyperchromatic nuclei and with many mitotic figures. Such is the appearance of cancer of the breast of the highest degree of malignancy, and in such cases, even when the disease is promptly recognized, a favorable result from treatment is rarely to be expected.

The classification of tumors in respect to their histological degree of malignancy has roused wide interest, and it is probable that there is justification for giving some weight to this factor in prognosis, although not all observers are agreed as to its significance. It must

not, of course, be thought to be the only factor, however, since we are dealing with a disease in which even the lowest degrees of malignancy, if neglected, are quite capable of causing death. Thus the extent of the disease, and especially the extent to which it has spread from its point of origin, will remain always one of the most important considerations. It seems probable, however, that cases of low malignancy are not so rapid in their spread, and that it is in this way that the more favorable results of treatment are obtained in the cases of this group.

So far as the histological estimate of radiosensitivity is concerned, it depends chiefly on the fact that rapidly growing undifferentiated tumors are, as a rule, more sensitive to radiation. This rule, however, like so many other rules, has its exceptions, and the final estimate of radiosensitivity must be qualified by experience; thus, basal-cell carcinoma, embryoma of the testis, certain parotid tumors, the lymphoepithelioma of Regaud and the endothelial myeloma of Ewing are among the tumors of high radiosensitivity; whereas squamous-cell carcinoma and fibrosarcoma are notoriously insensitive to radiation. The consideration of these facts is of great importance in determining the selection of the best treatment for the individual case.

Of all the different contributions to our knowledge and to our resources in the past twenty years, however, the application of radium and *x*-ray to the treatment of cancer is the factor which has had the most profound effect in changing the situation. During this period extraordinary progress has been made in the effectiveness of the application of these agents, and facts in regard to the results of treatment have been collected which amply justify the use of radium and *x*-ray, not only in the palliative treatment of advanced cancer, for which it has proved such a blessing to humanity, but also in the radical and curative treatment of primary, early and favorable cases of cancer in certain situations and of cancer of certain types.

During this period surgery has also been developed to a higher efficiency. The radical operations for cancer of different organs have been virtually standardized. Additions to the surgeon's armamentarium have been made, such as the introduction of high-frequency electrical apparatus, to produce cutting and coagulation effects which are much more delicate and efficient than the simple cautery.

The advantage of combinations of surgical and radiation therapy has also been developed in recent years, and surgery may be called upon to supplement radiation, or radiation may be employed to supplement surgery, as in the use of preoperative radiation or postoperative prophylactic treatment. This use of radiation has been very popular, and, although the earlier methods of *x*-ray treatment were probably somewhat inadequate to produce results, it is believed by many that the prophylactic *x*-ray treatment used at present is of much greater value as a preventive of recurrence after operation.

With all these facts in mind, our problem is to determine how this increased knowledge and these greater resources can best be made available for the more effective diagnosis and the more successful treatment of the individual cancer case.

One fact becomes immediately apparent: Neither the surgeon, nor the radiation therapist, nor any other single individual, can expect to qualify as competent, alone and unaided, in the diagnosis and treatment of cancer in its many situations. The problem has become too large and too complicated to be handled successfully by any but a whole group of individuals, including, beside the surgeon, the pathologist skilled in tumor pathology, the *x*-ray and radium specialist, the internist and the representatives of the special branches of surgery, such as nose and throat, genitourinary and neurological surgery, whose services are so essential in their own restricted fields. In this group, however, the general surgeon is called upon to play, perhaps, the most important part. By his general knowledge of the disease in the human patient he is the one best qualified to head the group and to secure that coördination of effort, that full and free discussion and that coöperative action which will ensure to the individual afflicted with cancer the best treatment available for his particular case.

To begin with, a surgeon who is properly trained in surgical pathology should know, perhaps better than any one else, the gross appearances and the course of cancer in its many variations and its different situations in the living patient. It would be surprising if this were not the fact, for the opportunities for close and accurate observation of the disease provided in the clinic and at the operating table are far greater than can be had in the autopsy room or in the laboratory. The differential diagnosis of cancer in its different situations is a matter very largely of experience, and in each situation a different group of nonmalignant and usually

surgical diseases must be considered before a positive diagnosis can be established. In a number of different regions of the body, instruments and apparatus of special design and requiring special and expert technique and experience, such as the cystoscope or proctoscope, are available and necessary for a complete study of the suspected cancer patient. Such methods of precision fall within the province of the surgeon, as does the final judgment of the significance of the observations secured by the diagnostic *x*-ray.

As a result of the campaigns for the education of the public and of the medical profession in regard to cancer which have been carried on by the American Society for the Control of Cancer, and by other agencies, cases often present themselves today for diagnosis before symptoms have developed which are sufficiently distinctive to permit a positive diagnosis of the disease. Under these conditions the surgeon is called upon to establish a diagnosis by exploratory operation. There has been much discussion in the past in regard to the advantages and disadvantages of biopsy. Undoubtedly, where a positive diagnosis can otherwise be made, an exploration is unnecessary. Laboratory experiments, however, appear to justify the statement that a clean incision into cancer tissue can be made without materially increasing the danger of dissemination of the disease, whereas, rough handling and massage are prone to hasten the production of metastases. In any case, the disadvantages of delay in dealing with an early case are so universally recognized that the exploration is accepted as the lesser evil. There are, of course, certain organs of the body, such as the ovary and the kidney, in which a precise diagnosis is not essential, since the disease, whether cancer or not, requires complete removal. In other regions, however, the operation for the radical cure of cancer involves such extensive mutilation that, in justice to the patient as well as to the surgeon, its performance should not be undertaken without a positive diagnosis.

Such cases demand the pathological confirmation of an exploratory operation. In the performance of these exploratory operations certain general principles have been established. The removal of small fragments of superficial ulcerated tumors, as in cancer of the cervix or the rectum, can undoubtedly be conducted without risk. A tumor beneath the surface of the unbroken skin, however, such as cancer of the breast or sarcoma of the long bones, involves further consideration. Such tumors should not be explored without

all of the preliminary arrangements having been made to complete the radical operation under the same anesthesia if a positive diagnosis of malignancy is obtained. We have repeatedly explored breast tumors in this way without interfering with the success of the subsequent radical operation. The biopsy wound is closed over a formalin sponge, a fresh layout of drygoods, gloves and instruments is used and the radical operation is completed immediately under one anesthesia. In the exploration of tumors of the long bones the use of the tourniquet is also a necessary precaution to prevent the possible immediate implantation of lung metastases.

In close relation to the exploratory operation is the surgical treatment of the so-called "precancerous" diseases. Many of these conditions, such as the keratoses and papillomas of the skin in elderly persons, are probably better treated by radiation than by operation; but when doubt exists as to the precancerous disease having already crossed the borderline and become cancer, especially in a situation such as the lip or tongue, where metastasizing cancer is prone to occur, operative excision with pathological examination of the tissue provides information which is most important to the further conduct of the case. Other lesions, such as the benign tumors and diseases which are recognized as of precancerous significance, demand operative treatment, such as the routine repair of the lacerations of childbirth after the childbearing period, in order to diminish the frequency of cancer of the cervix.

It is generally conceded that the radical operation which is capable of removing in one piece the whole of the local disease, together with the structures first in line of extension, provides the most positive and certain method for the permanent cure of cancer. Cancer of the breast is, perhaps, the best example, and in this situation the removal of the whole breast, the pectoral muscles and the deep fascia, together with the axillary contents, yields as high as 70 per cent "cures" on a five-year follow-up in early cases where the axillary nodes are not involved, and even 20 per cent in later and less favorable cases where the disease has already extended to the axilla.

Unfortunately, anatomical conditions prevent a radical operation so complete as that for cancer of the breast in many of the other common situations in which cancer occurs. It is these anatomical conditions which have prevented the so-called "radical" Wertheim operation for cancer of the cervix from more generally achieving its

purpose and have made radium therapy the method of choice for dealing with this disease. It should be admitted at once that a radical operation which fails to achieve its purpose, either because of the anatomy of the region involved or because of the wide extension of the disease, is a therapeutic mistake. Twenty-five years ago, when medical science had nothing else to offer in the way of treatment to the advanced cancer patient, forlorn-hope operations were perhaps justified. Today, with radiation therapy available, such operations can be regarded only as unnecessary and ill-advised.

The radical operative treatment of cancer in its different situations is today practically standardized in many clinics. Even so, however, the individual tumor and the individual patient give opportunity for considerable variation in the extent and completeness with which the operative removal is carried out. The best surgeons in the best clinics are conscientious and radical in the performance of these operations, and their statistics tell the story. There are, however, many surgeons operating today, even in hospitals of the highest standing, who, because of indifference or pessimism or for whatever cause, fall far short of performing the complete operation for the radical cure of cancer which modern surgery demands. In one-third of the cases of breast cancer which presented themselves in 1918–1920 at the Huntington Hospital, with recurrence after operation elsewhere, the operation which had been performed was so inadequate that it could never have been expected to cure the disease.

The selection of cases suitable for the attempt at radical cure by operation becomes thus a matter of very serious importance; and this selection must remain the province of the surgeon. In no case should this decision be made before a careful study of the patient has been made with reference to the known course and location of the regional and remote metastases of the particular type of tumor under consideration. The habitual employment of *x*-ray examination of the chest and of the bony skeleton, as a routine, undoubtedly saves many patients from unnecessary surgery; but the careful physical examination and consideration of the patient's symptoms, combined with a knowledge of the natural course of the disease, must always remain the chief reliance for protection against ill-advised attempts to achieve the impossible by heroic operations.

Although the patient, and frequently the surgeon, is dependent upon his gross senses of touch and sight for the detection of cancer,

we must not forget that, both in its original location and in its regional or remote metastases, cancer may exist in only microscopic proportions far too minute to be detected by sight or touch. It is for this reason that we are obliged to assume that microscopic extensions of the disease have already occurred, even when no gross evidence of enlargement of the adjacent lymph nodes can be made out. If the nearest lymph nodes are already grossly enlarged, we must, furthermore, assume that the next ones beyond are already the seat of microscopic invasion. This is the principle on which the standard radical operations are based, and abundant evidence of its truth is readily available. In a series of 39 cases of breast cancer at the Massachusetts General Hospital in which *no* clinical enlargement of the axillary nodes could be made out, 22, or 56 per cent, were found to contain cancer deposits on histological examination; and in another series of cases of cancer of the tongue and mouth, cancer in lymph nodes which were not grossly enlarged was found in 22 per cent.

While the assumption is a fair one that an enlarged lymph node in the drainage area of a tumor is malignant, this is not always the case, and, especially in the presence of an ulcerative lesion, the regional nodes may be enlarged by inflammatory reaction without the actual presence of metastatic cancer. It is dangerous to assume that such is the case, however, without pathological confirmation. Very minute foci of cancer in lymph nodes may, indeed, defy the efforts of the best pathologist to identify them, for only a very small fraction of a single node can be subjected to microscopic examination. It is, perhaps, for this reason that results not in accord with the pathologist's report sometimes occur. In any given case, therefore, it is necessary to assume that extension to the lymph nodes has taken place and that the field of microscopic invasion is at least one step beyond that of gross and palpable involvement. The adoption of this policy will save the surgeon from stumbling into many a case of inoperable cancer, and will save his patient the discomfort and expense, as well as the dangers, of an unnecessary operation.

Although the extent of the disease is probably the most important consideration in the decision for or against an attempt at radical operation for the cure of cancer, other conditions must be given due weight in the final judgment of the case. In these days of

insulin, diabetes has ceased to weigh so heavily as a contraindication to operation; but advanced disease of the heart or lungs or kidneys is still a significant bar to operative measures, and even extreme old age is worthy of consideration. In old persons, cancer, as a rule, progresses very slowly, and, with the additional retardation of the process which can be obtained by radiation, many an aged patient can be saved the mental and physical distress of an operation and enjoy entire freedom from annoying symptoms of cancer until life is terminated by one or another of the diseases of old age, although cancer is present all the time.

In connection with radical operative measures, a word should be said about the possibilities of modern plastic surgery. Operations of this nature underwent a great development during and after the World War, and have been employed extensively in the primary operative treatment of cancer, and secondarily in the repair of the gross defects and deformities resulting from the destructive treatment of the disease by cautery, electrocoagulation and radiation. It is true that the results of these operations are frequently not all that could be desired from a cosmetic point of view; but for functional results, especially about the face and in the repair of fistulæ, the patient estimates their value almost as highly as he does the cure of the disease itself.

Under the general category of palliative operations many different procedures are included which may be necessary either for the treatment of acute conditions which threaten an immediate fatality or for the relief of distressing symptoms. In the first group come the emergency tracheotomies, the operations by colostomy or by intestinal anastomosis for intestinal obstruction and the ligature of bloodvessels and transfusion for secondary hemorrhage. In the second group are the operations for the removal of offensive masses of necrotic tumor (for which the newer electrocoagulation and cautery proves so satisfactory); operations such as decompression for an inoperable brain tumor, a gastroenterostomy in cancer of the pylorus or a cholecystoduodenostomy in cancer of the pancreas. All are measures which will often allow the patient to die in reasonable comfort, when otherwise his distress would be extreme.

In general, however, partial removal of cancer tissue, except for the relief of some definite distressing symptom, is, I believe, to be condemned. I am altogether satisfied that the incomplete surgical

removal of axillary lymph nodes in cancer of the breast is worse than useless, and that the brawny arm develops more promptly and is more painful than when radiation therapy alone is utilized.

Perhaps, one of the most satisfactory surgical measures for the relief of pain in cancer cases is the use of alcohol injections in sensory nerves, as developed by Grant here in Philadelphia. In advanced cancer about the mouth and face, the relief afforded by this procedure is sometimes almost unbelievable. The value of operations for the removal of local recurrence following an unsuccessful attempt at radical cure is perhaps debatable. Occasionally, success results even after repeated secondary operations; but, as a rule, the more remote metastases develop and the patient dies. In certain types of disease, however—such as adenocarcinoma of the breast, adamantinoma and other forms of cancer which show widespread local invasion with less of a tendency to remote extension—secondary attempts at radical removal by more extensive operations are fully justified. The resources of plastic surgery and extensive skin-grafting are to be borne in mind in this connection.

Another group of cases which may be benefited by operative measures are those in which the surgeon's assistance is required to expose an area of local malignant disease for the direct application of radiation. This includes cystostomy for the radium treatment or cauterization of cancer of the bladder and the opening of the maxillary antrum for the direct application of radiation therapy. Combined treatment of this nature, by surgery and radiation, has been developed widely in the past few years.

I have reviewed a few of the activities in the field of cancer treatment which properly come within the province of the surgeon and justify his interest and participation in the modern clinic for the investigation and treatment of this disease. I would not, however, for a moment be thought to argue that cancer is in any way exclusively the surgeon's field. Such is emphatically not the case. The cancer problem is so wide that it can be attacked successfully only by a group of men especially trained in a number of different branches of science, and it is as one of this group that the surgeon takes his place. Such a group should work in cordial coöperation, and a better understanding of the difficulties and of the advantages of the different methods of treatment should be obtained by all of the participants. The partisan who advocates

exclusively the employment of a single method of treatment in every case has no place in such an organization, where the chief object should always be to supply such treatment, or such a combination of methods of treatment, as will give to that individual patient the best results obtainable with the resources now at our command.

In a country so large and so sparsely settled as ours the European method of attempting to provide for the treatment of all cases of cancer in institutes devoted exclusively to cancer treatment is impossible. Such institutes are too costly to permit of their maintenance in sufficient numbers to care for all of our hundreds of thousands of cases of cancer.

The vast majority of our cancer cases must be dealt with by our general hospitals and by physicians and surgeons in general practice. If each of these cases is to receive adequate treatment, some profound reorganization of our resources must be brought about. In my opinion the organization of cancer groups and cancer clinics in existing general hospitals offers the most immediate and practical method of improving the situation. On the staff of every hospital there are some physicians who are especially interested in cancer work. By a very simple reapportionment of duties, these individuals can be organized into a consultation group to deal with the cancer work of the hospital, and, with this responsibility and with the benefit of the mutual education which results from the close consultation of the pathologist, the radiotherapeutist, the internist and the surgeon, the way is at once opened for improvement of the treatment of the individual patient and for the advance of knowledge of the disease as well.

Groups of this nature have already been organized in many institutions. In such a group the surgeon should be the leader, but it should be as a presiding officer, not as an autocratic director, that he should take his place. He must strive to keep in the front of knowledge and ability in his own line, and to learn from the pathologist and the radiotherapeutist the facts they can contribute from their experience which will aid the patient to obtain the best collective opinion and practice of which the group is capable.

The American Society for the Control of Cancer and the American College of Surgeons are united in the recommendation that cancer clinics and cancer groups of this nature offer the most immediate and practical method of increasing the efficiency of the treatment of

cancer and of diminishing the frightful and unnecessary mortality of this disease.

In conclusion, therefore, we must remember that the resources now available for the treatment of cancer are capable of being employed successfully in a far greater number of cases than are receiving such treatment today; and that the quickest and most effective method for making these methods available to the community is by the organization of cancer groups and cancer clinics in existing general hospitals throughout the country where material equipment and professional ability are available, to take over the diagnosis and treatment of cancer as a group problem, with the full coöperation and consultation of the many different branches of medical science which are involved today in the modern treatment of this disease.

APPENDIX

INTRODUCTORY NOTE TO THE SECTIONS

Almost all of the papers read before the various sections of the College are subsequently published in full in medical periodicals.

The papers listed in the following pages may be found by consulting the *Index Medicus*, provided a sufficient length of time has elapsed from the date of publication to the next succeeding quarterly number of the *Index Medicus*.—[Editor.]

PROCEEDINGS

OF THE

SECTION ON OPHTHALMOLOGY

JANUARY, 1929 TO DECEMBER, 1929

JANUARY 17

Extensive Bilateral Retinal Detachment in Eclampsia, with Complete Reattachment

Dr. W. E. Fry (by invitation) reviewed the literature on this subject and reported two cases which occurred on the maternity service of the University Hospital during a period of twenty-five months. During this time there were 1024 deliveries: among these these were 173 cases of late toxemia, an incidence of 16.9 per cent; among the latter there were 19 cases of eclampsia, an incidence of 10.9 per cent. This gives an incidence of 1.2 per cent for retinal detachment among the cases of late toxemia, and of 10.4 per cent among the cases of eclampsia.

The first case was a colored woman, aged thirty-six years, admitted while in coma. There was bilateral retinal detachment which extended 12 diopters in each eye; there were numerous exudates and hemorrhages. Complete reattachment occurred in three months; the vision was 6/9 in each eye and the visual field showed a slight concentric contraction.

The second case was in a colored woman, aged twenty years. There was marked edema of both lids and a chemosis. The retinal detachment was bilateral and extended forward 12 diopters; there were no exudates or hemorrhages. The detachment was still present twelve days later. The patient was not seen again for six months, when complete reattachment had taken place. The vision was 6/15 in the right eye and 6/9 in the left eye; the visual field showed a contraction above in the right eye, but was normal in the left eye.

Discussion. Dr. William Zentmayer: As I understand the Leber theory, the fibrous tissue has its origin from the ciliary processes and courses parallel to the plane of the retina. If the detachment is due to such new-formed tissue, it is difficult to explain the reattachment. So far as the difficulty of explaining the possibility of the vitreous being dislocated by the elevated retina (except on the supposition of a hole in the retina) is concerned, it is to be recalled that we have solid detachment of the retina, which must give us a similar condensation of the vitreous without the tears in the retina.

Dr. Francis Heed Adler asked Dr. Fry if any holes were found in the detached retinas and, further, whether the tension was elevated immediately after the retinas had detached. Lister had pointed out the difference in prognosis between detachment with holes and those without holes, the latter being much more favorable, as would be expected.

Of the numerous theories of retinal detachment, the two most popular were the exudation theory and Leber's retraction theory. It would seem evident that these cases could be explained by the exudation theory, and the absence of holes would tend to support this view, since the production of a detachment by means of bands in the vitreous would almost necessitate the presence of tears which would allow fluid in the vitreous to come between the rod-and-cone layer and the pigment epithelium. One of the objections which has always been raised against the exudation theory was the supposition that one could not have such a detachment without either a rapid removal of fluid from the vitreous or a considerable rise of tension. In these cases, which seemed certainly due to exudation, if no rise of tension occurred it would prove that the argument was unsound.

Two Unusual Experiences with Infection by the Streptococcus Hemolyticus

Dr. H. Maxwell Langdon reported two cases. The first was that of Dr. A. J. B., who got hot cigarette ashes in his left eye on December 21, 1926. The following day a patient sneezed in his face. By noon the eye was conjested and watery, with some swelling of the bulbar conjunctiva. The eye grew worse in spite of treatment, the conjunctiva becoming very edematous, with a thin, watery secretion. Cultures were taken from the conjunctiva and blood. The former showed Streptococcus hemolyticus in pure culture; the latter were negative. The eye was quiet on January 17, but one week later there was a recurrence, this attack being slight and lasting for about five days. At no time was there any purulent secretion, the Streptococcus hemolyticus being a nonpus-producing organism. The eye made a complete recovery.

The second case was that of R. M., aged sixty years, who was admitted to the Presbyterian Hospital on December 7, 1928. He

gave a history of having been struck in his left eye the previous day by a piece of stone. His left eye showed a rupture of the cornea, the iris not prolapsed but the anterior chamber shallow and the lens hazy; the temperature was 100° F. The following day the cornea was completely hazed; the temperature was normal; *x*-ray was negative for foreign body. The eye did not improve and an enucleation was done on December 14. That night there was considerable bleeding from the wound and at noon the following day the temperature was 102° F. The stump was the site of a white, well-organized, tough, fibrous exudate, but otherwise looked normal. On the third day following operation the temperature was 103° F. and the exudate had increased. The patient died the evening of the fourth day. Postmortem examination revealed the following: Left sphenoiditis, from which a pure-culture Streptococcus hemolyticus was obtained; cultures from the orbit and blood showed the same organism in pure culture; there was also a left generalized meningitis and phlebitis of the left cavernous sinus. The sphenoid was probably the starting point of the infectious process. Would the final result have been different if an evisceration instead of an enucleation been done? He thinks not, as the cerebral involvement must have been present longer than two days and the operation did not affect the outcome.

A New Visual Test-card

Dr. Alfred Cowan showed a test-card arranged with letters previously described in the *American Journal of Ophthalmology*, August, 1928 (p. 625).

The letters are widely spaced, so that each may stand out as an individual test-object and in order to eliminate fatigue as much as possible. The gradation follows very closely the geometric progression proposed by Green, but the distances are so chosen that the Snellen fraction may be written in round numbers.

Discussion. Dr. William Zentmayer: Dr. Cowan has given us a test-chart based entirely on scientific principles which, therefore, makes it ideal for recording visual acuity. However, we use test-cards in our offices not only for recording visual acuity but for the purpose of subjectively determining the refraction error, so that a test-card constructed of letters which do not conform to a scientific basis for determining visual acuity are particularly suited for a determination of astigmatism. To resolve such letters as "K" and "X" requires that the astigmatism be very accurately corrected,

and such letters serve the purpose of deciding on the strength and axis of the cylinder, yet no worse letters could be constructed for estimating the visual acuity, because of a one-minute visual angle is lost as we approach the angles of the letter. It has always seemed to me that Landolt's optotype served well for estimating the visual acuity.

Dr. Cowan: While this card was primarily designed as a step toward standardization of test-cards for the notation of visual acuity, the letters offer excellent objects for subjective refraction. At the limit of visual acuity the letters are extremely sensitive, even a slight tilting of the card makes a noticeable difference of legibility. The Landolt "C" does not conform to the physiological requirements of a visual test-object. In this the patient is required only to locate the opening and, therefore, after a certain time, it becomes photometric and not a visual-acuity test. The value of the visual acuity will always be too great with a test of this kind.

Panophthalmitis Complicated by Pansinusitis

Dr. Sidney L. Olsho (by invitation) presented a case, Miss C. J., aged sixty-seven years, who was first seen at the Jefferson Hospital on September 28, 1927, complaining of poor vision. The right eye showed a leukoma of the cornea, the eye being quiet and the tension normal. The left eye showed numerous nebulæ of the cornea, vitreous opacities and widespread myopic choroiditis. She disappeared, to again reappear on December 11, 1928, giving a history of a painful and inflamed right eye for eight days. The lids were red and swollen, with ecchymosis of the conjunctiva; the globe was proptosed forward, downward and outward, and was immobile; the *x*-ray showed clouding of all sinuses and the rhinologist reported pansinusitis. A diagnosis of panophthalmitis was made. An evisceration was performed, following which pains subsided, and there was a prompt and progressive disappearance of edema and inflammation. Because of the rapid improvement following the evisceration, he thought the panophthalmitis was caused by a perforating corneal ulcer and was in no way due to an extension from the sinuses.

Discussion. Dr. William Zentmayer: The question of the relative safety of enucleation and evisceration in panophthalmitis has been discussed for years. About twenty years ago, Dr. Randolph did some animal experimentation, hoping to reach a conclusion. My recollection is that the results were unsatisfactory. Although they leaned toward enucleation being a safe procedure, Dr. Randolph decided that personally he was not convinced and preferred to treat the condition as he would an abscess.

Dr. H. Maxwell Langdon queried whether the result in his case would have been different had he performed evisceration. Literature shows that

meningitis is fully as frequent after the one as the other. Personally, I believe that there are other factors which determine the occurrence of meningitis in these cases. If there is not much orbital cellulitis, I prefer to do an enucleation. Where there is marked proptosis and swelling of the lids, I do an evisceration.

A Daylight Unit for Perimeters

Dr. Sidney L. Olsho showed a light unit that could be attached to the cylindrical weight of a McHardy perimeter. It employs the same center of rotation as the perimeter arm and gives an even distribution of a daylight quality of light.

Dr. Olsho also showed a screen for perimetry. The screen consists of four hinged panels, six feet high, and painted a neutral gray. This screen is especially valuable in an eye clinic, as it serves to isolate the patients, to exclude more or less from view objects distracting the attention and provides a neutral background. It may be folded up flat or used as a cabinet to protect the perimeter.

Discussion. Dr. H. Maxwell Langdon: It strikes me that the concentration of the light in one rather bright area on the arm of the perimeter is not very desirable if the field is taken in a room which is not generally well illuminated, as under such circumstances the retina would adapt itself for a low illumination, but be called on to do its work in a very brightly illuminated field.

Superficial Necrosis of Corneas Caused by Gas Explosion in a Hot-water Heater

Dr. Burton Chance: A man, while relighting the expired gas-burner of a water heater, received the exploded-air blast filled with dust particles on his exposed corneas. When examined, a few minutes later, the surfaces of the corneas were grayish; lacked luster, like the eyes of the dead. In the course of the next few days the entire epithelium exfoliated, but was completely reformed by the end of the eighth day, without further consequences to the corneas and to the sight.

FEBRUARY 21

Pulsating Exophthalmus

Dr. George Schwartzkopf, of Atlantic City (by invitation), presented a case of pulsating exophthalmus of the left eye, due to

traumatic aneurysm into the cavernous sinus. The case has been under his observation for almost two years. Surgical intervention had been impossible, due to the bad general condition of the fifty-five-year-old female patient. The exophthalmus appeared four weeks after a severe automobile injury, with fracture of the upper jaw, extending to the vault of the hard palate. The treatment was symptomatical and the digital compression which was tried for three weeks was not well stood. Nevertheless, the condition improved amazingly; temporary high tension of the left eye had once to be relieved by a cyclodialysis, as miotics did not relieve the pressure. In the first year after the accident the exophthalmus—its typical symptoms of bruit, tortuous conjunctival and retinal veins, thin arteries and retinal hemorrhages—varied as well as the subjective feeling. Diplopia with esophoria existed for about one month, but vanished spontaneously without recurrence. The patient is now feeling well, does all housework and has no complaints except that colds seem to cause slight increase of congestion in both (about equally prominent) eyes. Pulsation and bruit are distinct, the latter being only observed by the patient if her attention is called to it.

Bilateral Tuberculous Choroiditis

Dr. Abner R. Renninger (by invitation): A girl, aged ten years, with history of rapid failure of vision in the right eye, was first seen, January 14, 1929. Vision reduced to 3/200; ophthalmoscope revealed a crescent-shaped, grayish-white, elevated area to the temporal side of disc. In a few days there was general choroidal edema, dustlike opacities in the vitreous and deposits on the posterior cornea. Nineteen days later the left eye (which had been normal to this time) became involved in an identical way; the vision, however, did not fall below 20/70. A complete medical examination was made and the only positive findings were the tuberculin reaction and the presence of a calcification in the left chest. Treatment consisted of biweekly injections of tuberculin, mercurial unctions and increasing doses of potassium iodide. Subsequent history to date: The choroidal edema has entirely disappeared from both eye-grounds. There remains, however, in each eye several oval, white patches, which are located near the margins of large retinal vessels. Vision in the right eye has not improved; in the left it has been restored to 20/40+.

Discussion. Dr. Edward A. Shumway said that he had seen the child in consultation with Dr. Renninger and made a diagnosis of acute plastic chloroiditis *juxta papillaris* in the right eye, and advised sending her to the hospital for examination. The left eye subsequently became involved and the process rapidly advanced in both eyes. Recently the appearance of scattered yellowish-white areas gleaming through the retinal edema had made the diagnosis of a tuberculous choroiditis practically certain, especially as all other laboratory examinations had proved negative with the exception of the tuberculin skin-test, which was strongly positive. Dr. Shumway spoke of the two types of tuberculosis of the choroid: the miliary type, associated with acute miliary tuberculosis in its late stages, and the conglomerate type with the formation of a large tumor mass which showed the well-known characteristics of tubercle elsewhere—giant cells, with central caseation and surrounding epithelioid and round cells; occasionally the tubercle bacilli could be demonstrated. Dr. Shumway showed, with the projection lantern, a number of microscopic slides illustrating this condition both in the choroid and in the iris.

Schilder's Disease

Dr. Frederic H. Leavitt: During the past few years a disease process involving the subcortical tissues of the brain, occurring principally in young children and characterized by blindness, has been described in the literature. Paul Schilder, of Leipsic, in his original monograph, in 1912, defines the condition in the following way: "A diffuse disease of the white matter of the hemispheres occurring in childhood, which, because of the characteristic macroscopic and microscopic findings, may be regarded as a disease entity." Because of his very thorough description of the condition it has been given the name "Schilder's disease." Several writers before and since the publication of his article have described conditions occurring in children which are very similar in the clinical picture and in the pathological findings. Virchow first described this syndrome under the caption "congenital interstitial encephalitis," in 1867, and as late as December, 1928, Globus and Strauss appeared in print, taking exception to the term "Schilder's disease" and advocating the use of the appellation "degenerative subcortical encephalopathy."

The disease is fatal and there is but a slight tendency for remission. The majority of cases are rather abrupt in onset and run a rather rapidly progressive course. Blindness, with or without atrophy, varying degrees of coma, increasing generalized spasticity, with opisthotonos and decerebrate rigidity and myoclonic convulsive attacks, make up the clinical picture.

Pathological examination of the brains of patients dying with this condition reveals a decided hardness of the entire brain, with a general shrinking *in toto*. Microscopic examination reveals a practically normal cortex, with an intense degree of degeneration of the white fiber tracts, characterized by destruction of the myelin sheaths and axis cylinders and an overgrowth of neuroglia tissue. This destructive process frequently begins in the occipital lobes, accounting for the appearance of blindness in the early stage of the disease process, with no demonstrable changes in the eye-grounds. Occasionally optic atrophy occurs, secondary to the destruction of the visual centers.

The case that is being presented this evening is that of a mulatto male, aged four years. There is a history of gastrointestinal upset, followed by two weeks of apparent recovery, and then a rather rapidly developing syndrome characterized by disturbance of gait (cerebellar ataxia), increasing coma, myoclonic rhythmic convulsive seizures, increasing blindness with negative eye-grounds, dysphagia, decerebrate rigidity, with opisthotonos and normal temperature, spinal fluid findings, electrical reactions and blood pictures. This patient is still living at the Children's Hospital in Philadelphia, and, because of the resemblance of the condition to acute multiple sclerosis, he has been treated by intravenous injections of "germanine" every four days. The only improvement noted from this therapy has been the disappearance of the myoclonic convulsive attacks, the other characteristics of the clinical picture remaining as before.

Discussion. Dr. Edward A. Shumway said that he had examined the patient at the Children's Hospital a number of times, and, when the diagnosis was made, had urged Dr. Leavitt to present the subject before the Section, as one with which the ophthalmologists should be familiar. During the period that the child showed spasms of the face, the eyes also presented clonic movements, and at one time there was a definite conjugate deviation to the left. Because of the mental torpor, functional tests for vision were not possible, but the attending nurses reported a gradual failure of vision, noted in bringing food-cups to him, and at the present the child seems practically blind. At no time have there been any fundus lesions. Dr. Shumway had also seen the second case reported by Dr. Leavitt, and the optic nerves in this patient showed atrophy. He desired to thank Dr. Leavitt for his presentation of this comparatively new syndrome, about which a number of papers had appeared in the recent neurologic literature.

Dr. Joseph C. Yaskin said that Schilder's disease resembles multiple sclerosis not only pathologically by the exclusive involvement of the white

matter, but also from an ophthalmologic standpoint. In both diseases the doctor does not see, and the patient does not see, that is, the ophthalmologic examination reveals no cause for the blindness in the former, and the common occurrence of retrobulbar neuritis in multiple sclerosis has the same clinical manifestations. Another interesting point about Schilder's disease is that it sometimes occurs rather suddenly, resembling apoplectic form attacks, and again may, in one of its forms, resemble a brain tumor, so that useless operations were known to have been performed because of the failure to have recognized this condition.

Spontaneous Nystagmus

Dr. Joseph C. Yaskin (by invitation) said that, for clinical purposes, spontaneous nystagmus is divisible into labyrinthine, neurological and ocular types, based upon an etiological relationship to anatomophysiological changes, respectively, in the labyrinth and its vestibular projection, in the posterior longitudinal bundle and allied central structures and in the optical fixation. A simple and rapid method for determining the type of spontaneous nystagmus, as suggested in the presentation, consists of observing the type, direction, degree, frequency, amplitude, association and permanency of the nystagmus movements. These observations render it possible to determine the origin of the nystagmus in a few moments. The high frequency of ocular nystagmus is stressed especially, because it is the most benign type of nystagmus. The nature of diplopia occurring with nystagmus, independent of any extraocular muscle paresis, is discussed. The conclusion is that the diplopia under these conditions is due to rather serious involvement of the central nervous system.

MARCH 21

A Case of Massive Exudative Retinitis

Dr. Sidney L. Olsho presented a case of massive exudative retinitis in a young woman, aged nineteen years. The mother died of brain tumor at thirty-six years of age and the father of a stroke at seventy-four years of age; one sister has bilateral retinitis pigmentosa; two brothers and four sisters in fine general health; maternal grandfather and two aunts died of tuberculosis. The patient is in splendid general health. Physical examination, negative; Wassermann and Von Pirquet, negative. The condition of the left eye was first noticed one year ago.

Cilium in the Anterior Chamber for Seventeen Years

Dr. George H. Cross presented the case of a young man, aged twenty-six years, who had been referred for a foreign body in the cornea of the left eye. Upon examination, there was discovered a large cilium, one end of which apparently was fastened to the anterior surface of the iris at about 3 o'clock; the free end projected forward and nasally clear across the pupillary space.

Upon questioning the patient it was found that seventeen years ago he was struck in the left eye with a heavy piece of steel spring. There is a scar on the cornea showing the probable wound of entrance of this cilium, which is now in the anterior chamber. There is no apparent cyst formation and the patient has no discomfort. The removal of the cilium is not contemplated, as the patient says he has no trouble and is satisfied to let well enough alone.

Investigations on the Crystalline Lens

Dr. Allen C. Wood, of Baltimore, read a paper telling of the work of various investigators along this line. He said that we were still a long way from the solution of many problems involving the crystalline lens.

Discussion. Dr. Francis Heed Adler: The experimental attack on the problem of cataract reminds one of the fight with that mythical creature of the dim past who grew two parts immediately where one was cut off. As Dr. Woods has stated, the problem has been attacked from many different angles, and as a result those attacks which have been founded on earnest endeavor, and not inspired by the momentary flares of superficial "hunches," have rewarded us richly. At the same time we are confused by the vast amount of data which has accumulated and which keeps piling up with ever-increasing tempo. The chemist has left us with a more complete knowledge of the chemical units of which the normal lens is made, but an analysis of the relation of those units to one another in cataract has not yet been completed. The more the problem is studied the more complex does it become, as exemplified by the fact that now Dr. Woods is forced to speak of a gamma crystalline in addition to the alpha and beta forms previously recognized.

The artificial production of cataract in animals by radiation with ultraviolet light, by deficient dieting, by extirpation of the parathyroid glands, is gradually closing in the circle of our knowledge of the etiology of cataract; but the factors, if such there be, which are the exciting causes common to all these conditions have not been decided upon. Each time new data is procured the number of problems left unsolved seems to double and treble.

The discovery, by Gowland Hopkins, of glutathione and its application to the autoxidation system of the lens by Goldschmidt, Adams and others has further burdened our shoulders with a vast number of intricate problems which must be solved.

Finally, we come to the serological attack which Dr. Woods is so ably carrying on, and here I confess the tangle is almost too difficult and too specialized for a mere ophthalmologist to penetrate. There is, however, one factor which applies to all experimental work and which is most consoling. The development of any subject seems to occur in two phases: First, more and more details are accumulated, with an apparent increasing perplexity of the subject; finally, however, the data, like the parts of a jigsaw puzzle, begin to group themselves together into recognizable units, each group having a definite relation to the others. I look to Dr. Woods to be able some day to put these pieces together into their proper place, when, Eureka! the picture will be complete and simple.

Dr. I. S. Tassman: Dr. Woods' own investigations of the crystalline lens resulted in several noteworthy contributions. Just recently, he described the isolation of a third crystallin, which he called the gamma crystallin, and which he found to be an albumin. Moener, in his original classification of the proteins of the lens, spoke also of an albumin which, he stated, existed in very small amount and which he did not investigate any further. In an earlier work, Woods and Burkey described the separation of the various lens fractions and the preparation of serologically pure antigens at their isoelectric point. It was also of significance that they found the beta crystallin undergoes spontaneous precipitation on withdrawal of the alpha fraction, and seemed to support the view of earlier workers that senile cataract formation is, at least, accompanied by a disappearance or replacement of the soluble cystein-containing elements of the lens. This was often demonstrated by an absence of the nitroprusside reaction in cataract lens, whereas it is always present in the normal lens. This reaction was said to be due to the presence of cystein, an amino-acid element of the tissues which is autoxidizable. In its oxidized form, cystine, it does not yield the nitroprusside reaction. Heffter, in 1911, described this oxidation reduction as a process which takes place in the tissues and depends on the action of the H of the SH group present. Since cystein contains the SH group, its labile H is liberated when it is oxidized to cystine, and the reverse takes place in its reduction to cystein. But cystein had not as yet been demonstrated in its free state in the tissues. It was not until 1921 that Hopkins discovered that cystein exists in the tissues in combination with glutamic acid as a dipeptide, to which he gave the name of *glutathione*. This substance showed the same oxidation-reduction properties in the tissues as attributed to cystein, and is responsible for the presence of the positive nitroprusside reaction. Now, since the nitroprusside reaction is present in normal lens and absent in cataract lens, it can be assumed that glutathione is not present in cataract lens in its reduced form, which is the case in normal lens. The relationship of the possible oxidation reduction of glutathione taking place in the lens normally will require further study. This process in the tissues of the body is being investigated at the present

time and attempts are even being made to measure it. In the future, the possible development of suitable methods for this purpose may favor a better understanding and contribute to our knowledge of this biochemical process.

Report of a Third Hundred Successive Cataract Extractions in the Capsule After Preliminary Subluxation with the Capsule Forceps

Dr. Arnold Knapp, New York (by invitation), after defining the type of senile cataract which was suited for this procedure, spoke of the technic in the use of the capsule forceps and the method which he usually follows, emphasizing the necessity of, first, subluxation of the cataract before extracting in the capsule.

An analysis of a third series of 100 successive intracapsular cataract extractions was then given, describing the type of cataract, the mode of delivery and the visual results obtained. The visual results were, in 74 out of 100, 20/30 or better; vitreous was lost in 7; these were fully described and the resulting vision given. Iritis occurred in 8 cases, which were also fully described. Wound-reopening with hyphema occurred in 10 cases. Expulsive hemorrhage in 2: of these, 1 required enucleation; partial in the second, with preservation of the eye and some sight. Detachment of the retina occurred after one year in 1 case, and after a year and a half in a second case; the vision at first, after operations, being normal. Prolapse of iris in 1 case. Glaucoma in no case unless it was a part of cyclitis; in 2 cases glaucoma preceded cataract. After intracapsular extraction, tension remained normal.

Discussion. Dr. Luther C. Peter: It is always a pleasure to read or listen to a paper from the pen of Dr. Knapp. This evening's presentation, as usual, is concise, clear and timely, in view of the general trend of cataract surgery. You may be interested in contrasting an opinion of Isaac Hays, eighty-two years ago, which appeared in the American revised edition of Lawrence's *Treatise on Diseases of the Eye*, published in 1847. I quote the following: "When the section of the cornea is finished the great difficulty of the operation is past, the rest is easy. All that remains is to rupture the capsule of the lens. The lens might be forced out without previously opening the capsule, but the vitreous would probably be expelled with it." All will agree that the real difficulty begins after the section is completed. In contrast to this opinion, expressed eighty-two years ago, some may agree with Isaac Hays that the vitreous is apt to follow an intracapsular extraction. On the contrary, vitreous loss need not be any more frequent after a correctly preformed intracapsular extraction than after a capsulotomy

operation. In my paper, which is to follow, I will discuss briefly certain steps in lens extraction which tend to prevent vitreous loss in either type of operation.

Although I am an exponent of the intracapsular method, I believe operators may be divided into two groups: First, those who might advantageously practise a modern form of extraction with capsulotomy, and second, those in whose hands an intracapsular operation is justified.

In the first group might be included all beginners and older operators whose extractions during any single year are comparatively few. In the second group might be included any operator who has a good surgical hand and who has the opportunity for constant practice. Aside from the question of selecting either type of operation as best adapted to a specific case, the choice of an individual operator can be determined by his surgical ability and experience.

If we eliminate the surgical skill required for either method and compare the results of the two methods, there can be no reason for a difference in opinion as to the much greater value of intracapsular extraction. As pointed out by Dr. Knapp, vitreous loss, iris incarceration, vitreous opacities, after-cataract and secondary glaucoma are all reduced to a minimum. Recovery is more rapid, is uncomplicated, and a high degree of visual acuity is assured. Personally, I am disappointed when central vision of 6/6 is not obtainable in my work, and 6/5 and even 6/4 is more often obtained than less than 6/6. I am speaking of averages and not of individual cases.

Upon other occasions I have raised a protest before this Section against discission for after-cataract, which is so often made necessary by capsulotomy methods, especially when the somewhat antiquated cystotome is used for rupturing the capsule. In my experience, there is no intraocular operation which is attended by more danger than discission of an after cataract. Obviously this operation can be avoided by removal of part or all of the anterior capsule by toothed forceps. Even under these conditions there is an annoying complication, to which Dr. Knapp has not referred, which makes its appearance one or two years after the extraction and reduces vision unless it is met by a discission. I refer to epithelial activity, which may develop if any part of the proliferating section of the capsule is left in the eye. All these complications are eliminated by intracapsular methods.

Dr. Knapp is to be congratulated upon the very excellent results from the standpoint of complications. It is rather remarkable that he should have but 1 case of iris prolapse in a series of 100 cases. Vitreous loss of 7 per cent is average even in capsulotomy operations.

As to the method itself, one's individuality and experience are apt to bring about some variation in the technic. Dr. Knapp prefers to rupture the zonula by means of smooth forceps, and deliver the lens by the method which he described. In an uncomplicated case I prefer to use smooth Kalt forceps to complete the extraction, a Smith expression hook being used but little and with the slightest pressure. In my experience, if the lens is slowly withdrawn, vitreous will not follow. On the other hand, undue pressure with the Smith hook may cause vitreous presentation. Only experience

can be one's guide, and my technic differs from that of Dr. Knapp only as the result of the extraction of many lenses. Possibly his method works best in his hands.

The point for grasping the capsule is of much importance. If it is grasped near the lower border of the pupil, tumbling of the lens on delivery is insured, and breaking of the zonula is easier than when grasped at a higher position. Furthermore, if the capsule ruptures, as it occasionally does, the anterior capsule in the pupillary space is in the grasp of the forceps and is removed, and needling for an after-cataract will not be necessary. If the capsule is grasped above, as recommended by Verhoeff, a rupture of the capsule will be above the pupillary space, and a discission may be necessary.

The method is ideal and should appeal to the younger men who hope to give their best to their patients as their experience increases.

Dr. C. E. G. Shannon said that he had been privileged to see Dr. Knapp perform the intracapsular operation on 12 cases. He was impressed, first, with the thoroughness with which the eye was placed under control prior to the operation; second the delicacy and deliberation on the part of Dr. Knapp in carrying out the entire operation; third, the clear, black pupil that is shown following the delivery of the lens—a delight to every operator—and last, and of considerable importance, the absence of any accident in all of the 12 cases.

Such results as have been shown by Dr. Knapp this evening in his review of the last "100 cases," certainly merit the profound interest of every ophthalmic surgeon.

Dr. G. Oram Ring asked Dr. Knapp whether he routinely did a complete iridectomy in connection with his removal of the lens by subluxation with the capsule forceps.

Dr. Barraquer elects to incise a small piece of iris midway between the pupillary and ciliary border, and a recent communication from another operator suggested the propriety of omitting the iridectomy altogether.

Dr. Ring noted that Dr. Knapp had had two choroidal hemorrhages in this last list of 100 cases, and was interested to know how many accidents of this type Dr. Knapp had had in his entire intracapsular series of 300 cases.

Dr. Ring's own experience in that particular type of tragic accident, in a series of 2500 extracapsular cases, has only been 1 choroidal hemorrhage in each 500 extractions, and he is under the impression that Dr. deSchweinitz's experience had been similar.

Dr. Leighton F. Appleman stated that during the winter just past he had 10 cataract cases in which the lens had been extracted in its capsule. In 3 he had used the loop, carefully breaking the capsule at its upper border and gently insinuating the loop beneath the lens and delivering it without loss of vitreous. In the others, delivery was effected by pressure below with the Smith hook; but difficulty was experienced in breaking the capsular attachments below, and in the fact that there was slight loss of vitreous in some which, however, did not interfere with prompt healing. The method described by Dr. Knapp appeared to him to be an ideal method of operating.

Dr. Knapp: I agree with Dr. Peter that discission in many cases is

difficult and the proliferation which takes place from the margins of the cut capsular wound frequently interferes with the final vision. This same proliferation has occurred occasionally in the anterior layers of the vitreous in the intracapsular cases.

In answer to Dr. Ring: An iridectomy is always done at the time of operation. I doubt whether the choroidal hemorrhage can be ascribed to the operation. When expulsive hemorrhage takes place, the presence of the suspensory ligament and posterior capsule would not prevent its occurrence.

In answer to Dr. Holloway: I am of the opinion that detachment of the retina, which occurred in 2 of these cases, cannot be ascribed to the operation. Still it is difficult to convince the patient of this.

In conclusion, I do not wish to say that the capsule forceps is the only way to subluxate a cataractous lens. It is, I think, the simplest way, as we are all experienced in handling a pair of forceps. I am convinced that the tumbling method is essential to the safety of the operation, and I feel this is a method by which the advantages of the intracapsular operation can be obtained without subjecting the patient to the difficulty and risks of the original Smith technic.

Important Phases of a Satisfactory Senile Cataract Extraction

Dr. Luther C. Peter said that a change in method is indicated in this most important of ophthalmic operations when results are not satisfactory and it can be shown that accidents may be avoided by a change in technic. The complications which we endeavor to avoid are vitreous loss, iris prolapse, vitreous opacities, after-cataract, secondary glaucoma and the necessity for more than one operation on a single eye. Phases of lens extraction which tend to reduce these complications, in the author's experience, are:

1. Efficient anesthesia and motor block. Deep anesthesia of the ciliary ganglion is practised in addition to the usual local anesthesia, as well as motor block, both of which are practised in all cases if the blood-sugar is normal.

2. Marginal lid-sutures. They are introduced to control the lids during operation and tied after the extraction. They are left in place four or five days.

3. Lids are held by a well-trained assistant: A blepharostat is never used, because of difficulty in closing the lids promptly when required.

4. A generous conjunctival flap.

5. Two conjunctival sutures to prevent iris prolapse and insure rapid closure of the wound. A single suture favors iris prolapse.

These sutures are tied immediately after the lens is extracted, and toilet of the wound and anterior-chamber irrigation, if necessary, are carried out with safety.

6. Intracapsular extraction by means of Kalt forceps. A Smith expression hook is of aid when used judiciously, first, to render the capsule taut in immature and Morgagnian cataracts, so as to facilitate the grasp of the forceps; and second, in aiding the escape of the lens when the section is small or the lens is large. Judgment must be exercised in individual cases and a capsulotomy operation should be substituted in certain cases. To avoid the necessity of a discission for an after-cataract, the anterior capsule is best removed by toothed forceps.

7. Complete narrow iridectomy in preference to peripheral iridectomy.

8. Preliminary canthotomy is only indicated to facilitate the extraction in deeply set eyes with small palpebral fissures.

9. The operating room should be quiet, and spectators, if any, should be few for best results. The assistant and nursing staff should be carefully trained and instructed to observe silence during the operation.

The time element is unimportant if anesthesia is perfect, and the methods suggested are deserving of consideration because of the better results obtainable by the technic as outlined.

Discussion: Dr. Edmund B. Spaeth: There is but little I can add to this paper in its discussion of operative technic—that is, the treatment of cataract in the operating room—but, because it has been my fortune to have assisted Dr. Peter at all of his operative work for the past two years, I have jotted down a few points which might be further stressed.

During this interval of two years I have watched part of the development of this present technic as presented. Our present technic is the result of necessity in that, as complications threatened or developed, the mass of advice in the literature was drawn upon, utilized as far as possible and amended further by his own originality.

The first point is a willingness to change methods and technic as new factors are developed. A mind which was closed to the happenings of today and the probabilities of tomorrow would have killed cataract surgery at its birth. Without this willingness to change, the combined extraction would never have been perfected, intracapsular extraction and the peripheral iridectomy would have died with the demise of their originators. Further development must arise; test it if you will, but in all events receive it with an open mind.

The second point is, shall I say, a frame of mind in which we approach both the discussion as well as the actual execution of the operation.

A cataract operation is by all surgical rules a major operation, and must be considered as such in the requirements connected with it. Mills, in a recent paper on iris prolapse connected with cataract surgery, summed things up very well along this line when he stated: "Probably nowhere in ophthalmic surgery has disaster followed neglected application of first surgical principles than in cataract surgery."

Recently I spoke to a general surgeon, a man of international fame, and asked him if he could tell me in a few words the most important points in surgical technic. His reply was: "That is easy: Anesthesia, regard for tissues, prevention of shock, asepsis, adequate closure of surgical wounds," and then he added with a smile, "and a knowledge of anatomy and of pathology is the most important." He said nothing about manual dexterity, and when asked definitely about this, added: "If those I have just mentioned are fulfilled, then manual dexterity must have been present. It seems that a lack of 'surgical-mindedness' is the biggest hindrance in this phase of surgery."

The last point I have noted is relative to the use of sutures in cataract extraction. Before flap sutures were used, iris prolapse was entirely too frequent. As soon as an apex suture was used, the incidence of this complication was reduced very much. They still occurred, however, though less frequently. During the operation, one can see the reason for this quite readily. The unopposed pull of the superior rectus causes a gaping of the corneoscleral incision. The operative defect thus formed is in the shape of a crescent, concavity downward. As soon as this suture is placed, this crescent is subdivided into smaller crescents, one lying on each side of a vertical meridian. They are now more nearly triangular in shape and with their convexities in apposition. On the other hand, with the sutures placed in the outer angles of the incision and at the junction of the outer and middle thirds, the operative wound is snugly closed, so that one has just a bit of difficulty in worming into the lips of the wounds a flat irrigation tip or the respository spatula when this procedure is necessary.

The literature is full of all sorts of strange and bizarre events through which patients have passed in convalescence without damage only by reason of corneal sutures. This past week a patient, aged eighty-two years, fell from her bed the night of her cataract extraction without any damage whatever to her eye. She had had two well-placed corneoconjunctival sutures. On the other hand, about eight months ago, a patient of a much less-advanced age broke open her incision when reaching for the telephone four days following an uneventful capsulotomy-iridectomy extraction. Another case, six days after a similar operation, a few months before this, broke open his incision late one night when the nurse flashed a light into his face. As a large incision facilitates proper lens extraction without undue pressure on the eye (with a resulting traumatic iritis as its sequela), it seems even more necessary, as this tenet is carried out, that adequate sutures be used. It is a basic rule in abdominal surgery that the incision be sufficiently large to allow for proper manipulations. This is even truer

with extractio lentis. If for no other reason than this one alone, that of sealing-off potential infection from the vitreous chamber, sutures are indicated. The mental ease which these give to the operator is not to be lightly dismissed.

APRIL 19

Thiersch Graft for Symblepharon

Dr. Thomas B. Holloway exhibited a patient on whom he had operated for a symblepharon, produced as the result of a lime burn. The palpebral attachment of the adhesion occupied about 8 mm. in the central part of the lower lid, and extended to the margin; several bands crossed the fornix and were attached to the bulbar conjunctiva and the lower portion of the cornea. This last-named structure showed a marked and complete vascularization.

Both extremities of the symblepharon were dissected free and the cul-de-sac deepened. The lateral portions of the bulbar conjunctiva were then undermined and the margins sutured, so as to bring a flap over the cornea for about 1 to 2 mm. A piece of stent, about 5 mm. wide, had been previously molded to conform in shape to the contour of the lower cul-de-sac and almost corresponding in length to that of the lower lid. Two eyes were then placed in each end of the stent, large enough to permit the passage of a needle. A Thiersch graft was taken from the thigh, and, after shaping this about the stent, the latter was sutured in the lower cul-de-sac by means of a mattress at each end, which passed directly through the whole thickness of the lower lid. The loop of the mattress suture was placed between the inner surface of the stent and the outer surface of the inner fold of the graft. In this case, as with a previous one, a beautiful result was obtained.

A Case of Retinitis Punctata Albescens

Dr. Leighton F. Appleman presented a case of retinitis punctata albescens in a young woman, aged twenty years, of Jewish parentage, in whom the condition had been present since childhood and was probably congenital.

The chief symptoms were night blindness, with severe headaches, which were aggravated by her close clerical work. Vision: O.D., 6/9 − 1; O.S., 6/9 − 4. This was improved to 6/6 in each eye by

2.25 sph.; 1.00 cyl. axis 75 degrees in the right; 1.50 cyl. axis 80 degrees in the left.

Visual fields showed a slight concentric contraction for form, which was increased when they were taken under reduced illumination. Color fields were greatly contracted.

External examination was negative.

Ophthalmoscopic examination revealed hundreds of white, rounded, nonpigmented spots in the deeper layers of the retina and dispersed throughout the whole eye-ground in each eye. Both maculæ were free from the spots. The spots are unaccompanied by any pigmentary changes, nor has there been any progressive loss of sight. These facts, together with the symmetrical distribution of the spots, point to the congenital nature of the condition.

The blood and urine examinations were negative.

Examination of two sisters and one brother of the patient revealed no ocular abnormality. The father and mother of the patient were first cousins. This fact has been commented upon in previously reported cases and in the description of the condition.

Dr. Alfred Cowan made photographs of this case, which are very well done.

Discussion. Dr. Holloway stated that it had been his privilege to see probably more than his share of retinal cases belonging to this group, owing to his long service at the Pennsylvania Institute for the Instruction of the Blind at Overbrook. He simply desired to say that this was certainly the most beautiful case of this type that it had been his privilege to see, and he hoped that if any of the younger men had failed to see it, they would request Dr. Appleman to give them the privilege of examining the patient at some other time and place.

Reciprocal Innervation of the Extraocular Muscles in a Case of Bilateral Three- or Four-nerve Paralysis

Dr. Francis H. Adler presented a case of complete bilateral oculomotor paralysis which showed the following:

On extreme abduction to the right not only did the right eye turn out, innervated by the right external rectus, but the left eye turned in slightly toward the midline. On looking to the left the left eye could be voluntarily abducted and the right eye followed inward slightly toward the midline. There was no evidence of any power in any of the external ocular muscles save the external rectus on each side, therefore, the movement inward of either eye must have

taken place by a relaxation of the tone of the external rectus muscle. This relaxation of tone in one muscle when its antagonist is innervated constitutes the well-known reciprocal innervation first described by Sherrington.

(Paper will appear later in full in the *Archives of Ophthalmology.*)

Glutathione in the Crystalline Lens

Drs. I. S. Tassman and W. G. Karr (by invitation) stated that, employing the nitroprusside reaction as a guide, some of the earlier investigators concluded that the amino-acid, cystein, was present in the normal crystalline lens and absent in cataract lenses. Heffter, later, described the oxidation-reduction process of cystine due to the activity of its labile hydrogen atom of the SH radicle present in its molecule, and pointed out its possible importance as a factor in cell metabolism in the tissues. The substance had not, however, been demonstrated in the tissues in its free state. In 1921, Hopkins discovered glutathione, which he described as a combination of cystine and glutamic acid, and, after producing it from fresh yeast, he also showed that it was present in the liver and other organs. Glutathione, also, showed the same oxidation-reduction property in the tissues and was considered necessary in the proper function of the cell. Hopkins estimated glutathione in the liver of the rat to the extent of 0.18 per cent; in the liver of rabbit to the extent of 0.24 per cent. This was greater than the percentage found in other organs. Michail found it to be present in the lenses of oxen, rabbits and dogs to an average of 0.356 per cent. This exceeded the percentage found by Hopkins in the liver.

In our own investigation we used freshly extracted pig lens from animals of uniform age and weight, and after determining the percentage of dry matter (31.35), the percentage of glutathione was estimated, in a series of seven experiments, to be an average of 0.296 (according to the Perlzwig and Delrue modification of the Tunnecliff method). The total cystine obtained (Folin and Looney method) was in average of 1 per cent. The cystine percentage was, therefore, 0.704, giving an average equilibrium ratio of cystein to cystine of 0.42. It was also found that the process of desiccation reduced the percentage of glutathione in the normal pig lens to 0.224 per cent in a period of three to four weeks. A sample of fresh lens, extracted with 5 per cent trichloracetic acid and allowed to

stand at room temperature for twenty-four hours, caused a reduction of glutathione to 0.106 per cent.

In freshly extracted human cataract lenses the content of dry matter was found to be higher than in normal pig lens, averaging 35.5 per cent. In attempting to estimate glutathione in the cataract lens, it was found that there was practically none present. The total cystine in cataract lenses was estimated at 0.8 per cent, which was lower than the similar content in normal pig lens. This total, however, represented all cystine, since it was found that there was no reduced glutathione present.

From these results it is seen that glutathione is present in the normal pig lens in definite amount. An equilibrium ratio was established, also, between cystein and cystine. In human cataract lenses, glutathione could not be found in sufficient quantity to estimate. The cystine percentage obtained in human cataract lens was 0.8.

The effect of various influences on the oxidation reduction of cystein and glutathione has been described from time to time. Thompson and Voegtlin, in studying glutathione, felt that the toxic action of certain substances is due to a primary disturbance of the cellular oxidation reduction process resulting from a chemical interaction of the poison with the glutathione of the cell. In a long series of experiments they estimated the percentage of glutathione in the liver of rats at 0.183 per cent (according to Tunnecliff's method).

Future studies of glutathione and the development of methods for the measurement of the oxidation reduction potential in the tissues, may add more to the knowledge of the crystalline lens and its change from the normal to the abnormal state.

The Rôle of Calcium in Essential Glaucoma

Dr. Joseph I. Gouterman (by invitation) submitted experimental, clinical and therapeutic evidence suggesting the two main premises and their possible intimate relationship, namely:

I. A prevailing sympathetic hyperexcitability in essential glaucoma, brought about by—

II. A calcium disturbance. Calcium in the human blood is briefly discussed, pointing out the two forms of calcium, the non-ionizable and the ionizable or electrolytic variety. The author

favors the belief that the ionizable portion of calcium is diminished in glaucoma, the total calcium not necessarily being impoverished. The standard laboratory methods for the determination of the various forms of calcium are mentioned. The clinical characteristic features and their detection in cases of glaucoma are referred to. The paper is concluded with an outline of calcium therapy. Six cases, graphically illustrated, are reported.

OCTOBER 17

Some Interesting Fundus Pictures

Dr. Arthur J. Bedell, Albany, N. Y. (by invitation), exhibited a large number of fundus photographs from his collection of more than 10,000. His demonstration was divided into two parts: In the first, single pictures were thrown on the screen; in the second, stereoscopic photographs were presented by means of the anaglyph method.

Among the notable single plates were examples of drusen; various types of retinochoroiditis; angioid streaks; partial optic atrophy, where the difference in color between the affected and unaffected portion of the nerve was clearly distinguished; asteroid hyalitis and disclike degeneration of the macula.

The stereoscopic presentation included several cases of tuberculosis; preretinal edema; rupture of the choroid; stages in the progress of thrombosis of the retinal vein; an advancing hypertension; optic neuritis and choked disk.

He showed by serial photographs the development of angiomatosis; the primary circumpapillary exudate and the dilated vessels. He illustrated the massive exudate leading to the gross detachment of the retina and the iridescent perimacular crystals.

Seventy-five lantern slides made from his original plates were used to illustrate his talk.

The Clinic for the Treatment of Ocular Syphilis at Wills Hospital

Dr. Joseph V. Klauder and Dr. Harold Robertson (by invitation) said that our knowledge of syphilis in its clinical, pathological,

laboratory and therapeutic aspects has greatly increased within recent years. The literature of the disease has become voluminous. The number of new therapeutic agents is increasing. Treatment is becoming more complex, so that the therapeutic management of syphilis has, in a large measure, become the work of the specialist. The administration of so-called mixed treatment or mercury rubs no longer constitutes, as it did years ago, the limit of therapeusis.

A physician undertaking the management of modern therapy of syphilis should be familiar with the following considerations: The numerous preparations of arsenic, mercury, bismuth and other spirocheticidal drugs. Also, other therapeutic agents; their clinical status; their therapeutic index (ratio of therapeutic dose to lethal dose in experimental rabbit syphilis); their mode of administration; their toxicological reactions and the contraindications to their employment. What constitutes intensive treatment? Its hazards; when to employ it and when it is contraindicated. To weigh the hazard of treatment against the hazard of the disease. When to carry out a formula of treatment; when to individualize and fit the treatment to the patient. The dosage to employ; the interval between administration and how long to treat. The indications for a spinal-fluid examination. When a patient is a proper candidate for marriage.

A realization that a positive Wassermann reaction is not being treated, but rather a patient with a systemic infection, whose status is determined by clinical and laboratory examination. A comprehensive knowledge of the methods of laboratory and serologic diagnosis and the interpretation of positive and negative results. Such physician should be able to visualize syphilis as an infection from a pathological and clinical viewpoint and should be familiar with the subjective and objective symptoms of syphilis of the different organs.

In view of the complexity of modern therapy, the importance of "follow-up" system in proper treatment, of familial studies in patients with congenital syphilis and the many ramifications of syphilis in clinical medicine, it was deemed desirable to centralize the treatment of syphilis to one department at Wills Hospital.

The primary motive in the treatment of patients with syphilitic lesions of the eye should not only be the healing of the eye lesion, but the cure or arrest of their general syphilitic infection.

The attitude of the therapeutist should not be directed at an

inflamed cornea or uveal tract, but rather at the patient with a systemic infection having an ocular manifestation. Accordingly, the treatment of eye lesions due to syphilis should not consist simply of routinely administering antisyphilitic drugs.

It becomes necessary, through a complete examination of the patient, to determine the status of the syphilitic infection, and to adopt the treatment to the patient rather than carry out a routine or formulated plan of treatment.

Different case records are employed for patients with congenital syphilis, neurosyphilis and a third, marked "general syphilis." These case records were exhibited. The history, eye examination and physical examinations of patients in the different stages of syphilis was discussed.

A diagrammatic outline of the clinic was shown, each phase of which was discussed.

Since interstitial keratitis is a phase of congenital syphilis, its proper study embraces familial studies. Case records on lantern slides showed instances of such familial studies. Interstitial keratitis as a manifestation of congenital syphilis was discussed. Its appearance after trauma—the incidence of Clutton's joints was particularly discussed.

Neurosyphilis is notably represented by patients having optic atrophy and ocular motor paralysis. Examination of these patients notably concerns neurological, spinal fluids and examination to determine physical fitness for treatment.

Treatment is adopted to the patient in relation to the urgency of the case and the physical condition.

Case records on lantern slides were shown.

Patients with tertiary syphilis include those with uveitis; with pathological changes in the fundi; those with preoperative Wassermann reactions and those with positive Wassermann reactions whose ocular lesion is nonsyphilitic or of doubtful syphilitic origin. In this group it is necessary to fit therapy to the patient.

Patients with secondary and late secondary syphilis are represented chiefly by patients with uveitis. Since these patients are usually below middle age, a standard formula of treatment is more likely to be carried out than in any of the other groups.

Treatment of ocular syphilis was discussed in a general way. A standard formula of treatment suitable to all patients is not appropriate. The choice of antisyphilitic drug, dosage, interval of treat-

ment, conjoint treatment, intimately concern the age of the patient, the urgency of the case and the physical condition of the patient. The status of the different antisyphilitic drugs was discussed.

Discussion. Dr. J. Milton Griscom commented on the valuable aid which Dr. Klauder, through his department, has given in the treatment of various forms of ocular syphilis. He emphasized the fact that each case demands individual study by the syphilologist in order that the most effective forms of treatment may be used. Advances in the therapy of syphilis during the past fifteen years have been such that only one trained in this work is capable of selecting and applying one or more of the drugs now in use. This was well illustrated in Dr. Klauder's paper, by the absence of involvement of the second eye and recurrences in interstitial keratitis, under selective and intensive treatment. It is important that ophthalmologists recognize the possibilities of antisyphilitic therapy in this disease in which involvement of the second eye has by many been considered unavoidable.

Dr. Ernst Fuchs: We have seen so many interesting cases tonight showing the consequence of congenital syphilis which the unfortunate victims of this disease have to bear, that there is little that I can add. Years ago, I came across another ocular symptom of hereditary syphilis which may be little known, I know I have only seen one paper, which I believe was read at a meeting in Belfast, and these patients with hereditary syphilis sometimes have vertically oval cornea. In these cases we have vertical ellipsis and a higher degree of astigmatism. I do not hold that all cases of this type of astigmatism are syphilitic, but certainly a great majority of them are.

What I would like to know is if any such cases have been observed in children in the first year of life? In a summary of this type it would be interesting to know if any of these cases have been observed developing during the first year; if so, it would contribute to the symptoms of inherited syphilis.

Dr. Robertson (in closing) said that he believed that a clinic of this type had a definite place, if only for the treatment of interstitial keratitis, for, as had been said, under this form of treatment, in a study of over 100 cases, recurrence had followed in only 6 per cent, which was greatly less than formerly. It is also interesting to note that 52 per cent of all persons with congenital syphilis, brought to medical attention, have or have had interstitial keratitis, and that only 22 per cent have normal vision. In children this means many days' absence from school, long periods of photophobia and discomfort, and in many instances mental disorganization for the rest of life.

It is interesting to note that interstitial keratitis leaves restricted or actually damaged vision, only 60 per cent ultimately recover full vision. This is very unfortunate, when modern methods of treatment resulting from a clinic of this type bring such great relief to the interstitial cases.

Case of Drusen

Dr. Warren S. Reese showed a case of drusen of both nerve heads. He called attention to the fact that this affection is perfectly consistent with normal vision when there are no other ocular complications.

NOVEMBER 21

Glioma of the Retina

Dr. Chance brought a boy, aged ten years, who had come to the hospital only a few days before because his parents had noticed, in the past few weeks only, a whitish reflex behind the pupil of his left eye. Dr. Chance had not had the opportunity of examining him thoroughly, but, as he had been admitted to the ward, hoped to do so.

Deep in the nasal half of the fundus there is a mass which looks like beef-suet; on it there are a few vessels and it projects outwardly somewhat like a glioma mass. In the temporal half of the fundus two or three other areas can be seen; they appear as though they had punctured through the retina and choroid. There is no history of injury nor of inflammation.

The reason for bringing the boy was for assistance in diagnosis. Dr. Chance had regarded it as one of massive exudation. If it should be a case of glioma, he had never seen one like it, although he had been consulted in quite a large number of gliomatous cases (by actual count fifty-six). The case is older than any one he had seen exhibiting early symptoms. The eye has shown no signs of inflammation or of congestion. The tension has not been elevated by finger touch and the anterior chamber is of normal depth. The tension tonight is a little higher, probably because of pupil expansion and other manipulations of the eye; it has not been present previously.

Dr. Chance hopes to show some slides to explain the strange appearance, later.

Discussion. Dr. E. A. Shumway said that he thought the sooner the eye was out the better. The vitreous is comparatively clear, the mass itself is smooth and somewhat vascular and these scattered masses on the

retina are exceedingly suggestive of what we get in microscopic examinations of glioma of the retina. In a great many of the cases which he had examined microscopically in the early stages, when the eyeballs are not entirely filled by the tumor mass, you find on the surface of the retina collections of tumor cells which are metastatic growths or additional growths. The present case shows this condition and Dr. Shumway would be strongly inclined to make glioma of the retina the diagnosis.

A Case of Krukenberg's Spindle

Dr. J. M. Griscom and (by invitation) Dr. I. S. Tassman reported the case of a colored woman, aged thirty-six years, married and the mother of two children. She complained of aching of the eyeballs for about one year. Family history and past medical history were negative. Vision: R. E., 4/40; L. E., 1/40: With glasses: R. E., 5/40; L. E., 5/40 (Cowan's test-card). She revealed a high degree of myopia.

External examination with undilated pupils showed right pupil to be about 4 mm. and the left about 2 mm., no reaction to light; convergence poor. With oblique illumination, in each eye there could be seen a linear brownish streak extending down the center of the cornea, vertically, from just above the middle to within 1 mm. from the lower limbus at 6 o'clock; they appeared to be symmetrical. With the pupils dilated under homatropine they appeared in the same position, brown in color and somewhat fusiform in shape, when examined with the ophthalmoscope. They appeared to be in the posterior layers of the cornea and to be composed of a large number of closely placed individual dots. No remnants of pupillary membrane could be seen. In the right eye there were star-shaped striations in the center of the lens posteriorly. In both eyes there were numerous floating, filamentous opacities in the vitreous. Both eyes, also, showed an old extensive chorioretinitis and the nerve heads were pale in color. The perivascular sheaths of many of the vessels were also prominent.

The Wassermann and Meinicke reactions were strongly positive. Teeth were in very poor condition and examination of the sinuses revealed a marked reaction of inflammation in both ethmoid regions.

Examination of the right eye with the slitlamp showed the anterior portion of the cornea clear. Over the entire posterior surface of the cornea were scattered fine, brown granules, densely

arranged in the center to form a vertically oval configuration, extending from just above the lower limbus to about halfway between the center and the limbus above. The dots were more and more scarcely distributed toward the periphery. Most of them appeared to lie in front of the endothelial cells, although some might be behind. Iris was markedly atrophied. Anterior surface of the lens contained some fine brown-pigment granules resembling those deposited on the cornea. At the posterior surface of the lens could be seen a translucent, white, membranous deposit arranged in the form of radiating spokes with the center at the pole. This was absent in the left eye, the examination of which otherwise resembled that of the right.

Discussion. Dr. Luther C. Peter said that he reported a case of this kind before this Section in 1927. That the patient was unusual in that she was a hyperope, aged fifty-four years, with low-grade chorioretinal disease of long standing.

The evidence as to the etiology in these cases is in favor of an acquired condition. The age of the patients and the fact that it usually appears in myopes and in elderly people are against the congenital origin of the condition.

The distribution of the spindles is difficult to explain: first, in that they are bilateral; second, in that they occupy a vertical position directly in the center of the cornea; third, in that the spindles, as a rule, tend to approach more nearly to the lower limbus than the upper.

In the case which I reported the center of the spindle was rather dense and the peripheral borders were frayed and branched in appearance—made up of more or less stellate spots—just as though washed and thinned out by the aqueous current. It is not unlikely that the aqueous current is responsible for the peculiar distribution of these deposits, because they occur in what seems to be the most active part of the current.

It is probable, if these cases were carefully studied, a low-grade chronic inflammation of long standing, such as is often observed in myopia, would be found to be present in each and every case. In the case which I reported the deposits were located on the posterior surface of Descemet's membrane.

Dr. T. B. Holloway said that some nineteen years ago he reported 3 histories of such cases, and at that time tabulated the case histories then on record, some 9 or 10 reports. Nearly all instances of this pigmentation have occurred in myopes and when astigmatism has been present it has generally been oblique. Since the above, I have seen at least 3 and probably 4 other cases. One of these was first seen in 1916, again in 1917, 1918 and 1919, and my notes fail to mention any signs of pigmentation. All of my patients are examined by oblique illumination as well as with the ophthalmoscope, and one is not apt to overlook ocular conditions he has once recorded, so it is difficult to believe it could have been overlooked. The

patient was seen again in 1926, when a definite spindle was noted in the right cornea and my notes briefly state, "with slitlamp fine punctate pigment dots, slightly variable in size, on and anterior to Descemet's membrane."

In view of recent developments, I suggested to one of my friends, about two weeks ago, that it might be well to round up the cases I have seen and subject them to accurate slitlamp examinations.

In regard to the etiology: Until recently I had always been under the impression that the condition was congenital. This brings up the old question as to whether certain of the so-called congenital conditions are truly inflammatory or are developmental abnormalities. I do not agree with Dr. Peter that if we examine all of these cases we will find evidence of intraocular inflammation, because it was not true in certain of my cases nor in certain other of the recorded histories. The only way this could be accepted would be to assume all myopic cases as of inflammatory origin and that the myopia was primary in each instance.

In view of the instance above cited and certain other cases now on record, I am beginning to lean toward the possibility of this pigmentation being an acquired manifestation, at least in certain instances.

In conclusion, Dr. Griscom said the case was presented as a clinical report, and the literature on the subject was not considered because an exhaustive review of the subjects was in process of preparation by Dr. Edgerton, of the second-year class of the Graduate School of the University of Pennsylvania. This will probably be presented for publication within a reasonable time.

It is difficult to conclude that these cases are congenital in origin, because of the fact that very few show any other sign of inherited ocular defects. It seems rather strange, too, that Krukenberg spindles should be found in adults and not discovered earlier in life, if they are congenital. Dr. Griscom felt that they are more likely to be acquired and perhaps have some association with progressive myopia.

Vitreous Hernia Following Trauma: Demonstration by Hand Slitlamp

Luther C. Peter, M.D.: Rupture of the left cornea down and in, near the limbus, resulted in iris incarceration, slight traumatic cataract and some dislocation of the lens, with prolapse of the vitreous through the ruptured zonular fibers.

The case was presented because of this series of phenomena, and especially because the vitreous hernia was demonstrable by means of the hand slitlamp. Although this rather simplified instrument of precision is not as refined as the large slitlamp, it is most practical in uncovering and analyzing many details in the anterior segment of the eye.

The visual results in the case were good, but the iris incarceration, the dislocation of the lens and the vitreous hernia may bring about definite pathology in the future. Instead of replacing the apparently uninjured iris, excision was the better mode of procedure. As the iris returned so readily, with a round pupil, the inclination was strong to take a chance. It is better surgery, however, to excise the protruding iris; there is less danger of infection and less likelihood of anterior synechia.

From the compensation standpoint, it is best to write into the report of such a case the possibilities of further complications, because of the anterior synechia, lenticular dislocation and vitreous prolapse; it is but fair to the patient.

A final point which this case stresses is the necessity for careful study of our cases by instruments which are more refined than that of the ophthalmoscope and oblique illumination. The loupe is useful, but does not possess the wide applicability and differentiation of the slitlamp, even in this most simplified form.

Extensive Cellulitis of Lids and Scalp in a Child

Dr. G. E. deSchweinitz and Dr. A. G. Fewell reported a case of severe cellulitis of the lids complicating chickenpox in a child, aged eight years. The diagnosis of chickenpox was made on May 24, 1929. The cellulitis of the left lids was first noticed three days later. The infection of the lids had evidently started from a small pock from which pus was expressed, on the side of the nose near the inner canthus. The temperature jumped from 100° to 105° in a short time. When first seen the lids were completely closed, brawny and of a putty color. Both lids were incised, a small amount of pus being obtained from the upper, but none from the lower lid. A culture taken at the time was reported as pure Streptococcus hemolyticus. Considerable pus was obtained from each lid the following day. Small rubber drainage tubes were placed in each lid. In spite of seemingly free drainage the patient continued to run a typical septic temperature and seemed very ill. The cornea was not affected and there was no proptosis of the globe at any time. A blood culture taken at this time was negative.

On June 7, there was some swelling extending from the outer canthus to ear, evidently a pocket of pus forming beneath the skin of the upper part of the face. An incision was made just above

and in front of the left ear on June 11 and through-and-through drainage established. The temperature gradually dropped to normal within a few days and convalescence was rapid. The lids healed rapidly and now there is very little evidence of scarring.

Instantaneous Color Photography of the Human Eye

Laurance D. Redway, New York: There are few who do active clinical work in ophthalmology, and especially those concerned with undergraduate or postgraduate teaching, who will not appreciate the extraordinary advantages to be gained by the application of instantaneous color photography to this work. In the past, to say "color photography" was to conjure up a vision of infinite complexities in which, as in a murky haze, dark phantoms with hands indelibly stained with outlandish chemicals and special cameras of weird design were seen under a pall of comparative secrecy. And it must be admitted that, until recently, this vision was not altogether unwarranted. A person dealt with color photography as a hobby or as a solace in advancing years; certainly it had no place in the practical life of the day; and reasonably so, because at that time its methods were so uncertain, its results so horrendous, that only an enthusiast would tolerate them. A flair for color photography at that time was considered almost as a mild dementia. But improvements in methods and materials in later years have advanced the art far beyond earlier expectations. In fact, it is fair to say that to take and to finish a color plate, such as those here to be shown, is now possible in about fifteen minutes; a feat not practical even with the ordinary black-and-white snapshot with a kodak. Simplicity, then, has superseded the old clumsy methods and has reduced color photography almost to the status of a mathematical equation, solvable by any one with a common high-school education.

It is true that outdoor color photography, dependent on varying intensities and qualities of daylight, still requires a considerable training and practice to produce proper results, but in instantaneous color photography of eyes it is now possible to work under carefully calculated and controlled conditions of illumination and exposure, assuring under such control almost perfect results.

Granted the simplicity of operation and reliability as to results,

what are the advantages to be gained? If you will consider the inadequacy of our present black-and-white halftone textbook illustrations to convey in most instances an exact idea of what they are supposed to represent, the question is half answered. Except where stereoscopy is resorted to, with its necessary accompaniment of cumbersome paraphernalia, black-and-white illustrations lack contour; they are lifeless and dead. The same is true of projected transparencies of this order. To obtain good color illustrations, either for textbook or classroom work, the services of a good artist are required; and to obtain one, a good one, and at the time he is wanted, is often not a simple matter.

Consider the matter of clinical records. It is desired to demonstrate a case of acute herpes of the cornea, a pigmented sarcoma at the limbus or a hypopyon ulcer. If your experience coincides with ours, there is probably no such case in the city at the time, there seems to be what amounts almost to a conspiracy of sorts in the matter.

But with adequate color records available for demonstration, it is not only possible to show what is desired at the time, but also what is otherwise impossible under any circumstances, namely, consecutive records of a single case from its inception to its discharge, its behavior under treatment, its reactions to medication, the results of operative work.

These things are instantly available to the instructor. They become available in color, thus affording what in many instances is the chief diagnostic feature of the case, and they become available in contour. For the projected color plate by color interference is viewed pseudostereoscopically and thus its planar definition is preserved, the illusion of depth being relatively perfect.

Apparatus necessary to the work is simple. Essentially, it consists of a horizontal microscope and a source of light, the relations of these being permanently fixed. A small pilot-light affords sufficient illumination for focusing. The patient is seated as for a slitlamp examination. The eye is exposed to no light whatever, save to that of the pilot-lamp, until the instant of exposure. Even this feeble pilot-light can be varied in intensity if desired, so that the state of the pupil can be controlled at will. The exposure being for approximately $\frac{1}{50}$ second only, the eye is perfectly static, and, as the light beam is incident to the pupil at an angle, the greatest

intensity does not fall on the macula. There is a short following scotoma, but no further effect on the patient. Since the focusing light is subdued and the exposure so short, even very light-sensitive eyes may be thus photographed without difficulty.

The finished transparencies may then be projected. Because they are smaller than the normal lantern slide, a kit must be used to adapt the ordinary projection apparatus to this use, but that is the only change necessary to be made. The small size of the plate is, however, a very practical advantage in the matter of transportation and of storage.

As to permanency of color, many of the plates here shown are over a year old, and have shown no tendency to fade, although they have been repeatedly exposed to the intense light and heat of the projection lamp. Copies of these plates can readily be made, and, therefore, valuable originals can be stored safely and used merely for the production of subsequent copies.

Heretofore, it has not been possible to reproduce such screen plates satisfactorily both as to color and detail by the four-color photoengraving process; but, due to the kindness and interest of Mr. Harry Groesbeck and the Walker Engraving Co., of New York, new developments have been made during the last year obviating this difficulty, as you can see by the very excellent reproduction here shown. With the possibility of printed reproductions, the facility with which the plates may be copied and the simplicity of making them in mind, there seems to be no good reason why color photography should not be widely adopted by ophthalmologists as a teaching adjunct and as a means of improving the general quality of textbook illustration in the ensuing years. I shall not even attempt to touch upon its usefulness in medicolegal work or upon its possibilities as an aid to research.

Naturally, it is impossible to deal adequately with a subject of this kind in a paper. The plates themselves tell the story and do their own pleading. But I have attempted to introduce them to you by anticipating some of the questions which will naturally arise as a consequence of the consideration of a new subject, probably foreign to most of you, but, nevertheless, one in which further development and improvements may be daily anticipated as the attention of the profession is called to its possibilities.

DECEMBER 19

Glioma of the Retina

Dr. Chance reported further on the case of the little boy exhibited at the November meeting, which was believed to be one of glioma. The eye was enucleated a few days after the meeting. The mass had increased so extensively that it was almost impossible to find any ordinary reflex when the ophthalmoscopic examination was made. Dr. DeLong and he are still struggling to find something more definite; yet up to this afternoon nothing but exudative products have been found in the sections. They are forced to state that it is not a case of glioma.

Pagenstecher's Sutures for Ptosis

Dr. Chance brought a young man to show to the Section, as he thought that all might be interested to see the effects of so simple a procedure as that of buried suturing. When he was first consulted, the right upper lid covered the eye and could not be elevated, but now the man is quite able to open the fissure to the full width. The sutures were made of rather thick, heavy, rough silk, and a short, broad needle, curved on the flat, was used, so that, in the cicatrization following, the tract was quite wide. The sutures came out one after another on being tightened day by day. The tracts thus made are cicatrizing and contracting, so that there is a fairly wide fissure which it is hoped may be permanently maintained. What shall be required later is problematical, yet at present the result is quite satisfactory, and, therefore, perhaps nothing else shall be required.

Zonular Opacity of the Cornea

Dr. Mary Buchanan brought, to show to the Section, a little boy who had come to the clinic at the Woman's Hospital from Coatesville. He was very much frightened and no history could be obtained. About eight months previously something white was noticed in the pupil of the left eye. There was no history of injury, the eye did not hurt him and did not seem to bother him at all.

The pupil did not dilate and appeared to be bound down. He could not count fingers; but the next day after a solution of atropine was used, he counted fingers at 8 inches. The light projection was

very poor. There are calcareous deposits in the lens, which is cataractous. There was no view of the fundus. Transillumination was tried but was unsatisfactory, as the boy began to cry. As no slitlamp was available, this examination could not be made.

Dr. Buchanan wished to know whether there was any immediate danger from keeping this eye in, and if there was a possibility of the condition being due to a new growth.

Discussion. Dr. Reese said he believed that he had seen this boy before, and was much interested, particularly in the corneal condition which he believed to be a zonular keratitis. He thought this was rare in such a young individual, although he had seen another similar case.

Dr. Chance stated that if the disease of this eye is not dependent upon the retention in it of a foreign body, the present appearance reminds him of certain cases of metastatic deposits he had seen in the course of acute infectious diseases in which there were signs of uveitis of progressive severity.

Dr. Zentmayer said, in connection with Dr. Reese's observation, that he had recently seen, in consultation with Dr. Heed, a girl, aged six years, with bilateral uveitis, in which both eyes showed a beginning zonular opacity of the cornea. In one eye vision was light perception and in the other nearly normal.

Dr. Shumway asked if an *x*-ray of the eye had been taken, and reminded the Section of a case of Dr. John Carpenter, in which an eye had been removed for panophthalmitis supposedly due to an attack of mumps. Microscopic examination later, however, showed the presence of a piece of steel which had flown into the eye as the boy was standing beside a blacksmith's anvil.

Dr. Buchanan, in closing, said that the possibility of a foreign body had been considered at first on account of the position of the two linear corneal opacities concentric with the limbus, but the *x*-ray was negative. The only history is that the child had tonsillectomy at the age of four years and has been well since; there has been no recent illness. The maternal grandmother had tuberculosis.

A Case Exhibiting Active Circulation in the Posterior Part of the Lens

Dr. Charles A. Young, of Roanoke, Va., (by invitation) showed a young white man aged seventeen years, first seen October 15, 1929, complaining of pain in the left eye.

Examination showed the following: Vision without glasses: O.D., 6/4; O.S., 6/7.5 + 1. Binocular vision normal. Cycloplegia shows hyperopia in each eye, and with a +0.75 sphere over the right eye obtains vision of 6/4 + 4; with a +1.25 sphere over the left eye,

vision of 6/6 + 2. Near points No. 0.50 M type without glasses: O.D., equals 9 cm.: O.S., equals 10 cm. Muscle balance negative, except for 12 degrees of exophoria at 33 cm. Left eye shows a small pterygium on the nasal side. Pupillary reactions and tension normal in each eye.

Ophthalmoscopic examination: O.D., negative; O.S., shows an opaque plaque slightly nasal to the anteroposterior axis of the lens, from which extends a persistent hyaloid artery which looks black with the ophthalmoscope. Upon rotating the eye upward and downward, middle portion of hyaloid artery swings with the motion of the eye, but is fixed both at its anterior and posterior extremities.

Both Dr. deSchweinitz and Dr. Zentmayer are of the opinion that the hyaloid artery is attached to the inferior nasal branch of the central artery of the retina.

Examination with the corneal microscope shows an opaque plaque in which there are three capillary loops which show active circulation and are branches of the hyaloid artery. The hyaloid artery has the appearance of a white band when the light is concentrated on the artery, but with the light to one side gives the red appearance of a bloodvessel.

Discussion. Dr. deSchweinitz said that he had examined Dr. Young's patient with the slitlamp and found the conditions described by the essayist —an unusual and highly interesting picture. He had been unable to find in Vogt's or Meesman's *Atlas* a plate of a similar conditions.

Dr. Zentmayer said that, as seen with the ophthalmoscope, there are opaque lines radiating from the base of the attachment of the hyaloid artery to the posterior capsule of the lens. These are not the bloodbearing vessels seen with the biomicroscope, but may be either folds in the capsule or empty vessels. The vessels seen with the biomicroscope are probably remains of the posterior vascular capsule of the lens.

Unilateral Buphthalmos

Dr. T. B. Holloway and Dr. A. G. Fewell presented a case of buphthalmos in a colored female child. The patient, who was then aged five months, was first seen in the eye clinic of the University Hospital in August, 1929. The mother had noticed the day previously that something was wrong with the child's left eye. The

child had never been ill and had developed normally. There are two other children, both normal in every way. Neither mother nor father had ever had ocular trouble.

When first seen in the clinic the right eye appeared normal in every way. The cornea was clear and measured 12½ mm. The anterior chamber was of normal depth. The pupil 4 mm. and active to light. Finger tension, normal. The left cornea was quite cloudy over its whole surface and measured 14 mm. The anterior chamber was deep, the pupil seemed dilated and very sluggish to light. Finger tension, +. A mixture of 1 per cent pilocarpin and ¼ per cent eserine was ordered to be used in the eye four times daily. When seen two days later the cornea was clear and has remained so until the present time, as long as the drops are used.

We present this case because of the early age at which the buphthalmus appeared, and also for suggestions as to treatment.

Dr. Holloway said he thought this case would be of interest, as it seemed to him that it was unusual to see a case of buphthalmos at so early a date. It was the youngest patient of this type that he had seen. While the case had been described as a unilateral one, it was believed that symptoms were beginning to develop in the other eye.

Dr. Holloway said he had first seen the case a month previously, and at that time there were subacute signs which had cleared up after the administration of suitable myotics.

The case had again reported within the past few days with a haze in the cornea, and the question came up as to what should be done for the tension. Practically all types of operative procedures appropriate for glaucoma have been resorted to for this condition, and to the best of Dr. Holloway's knowledge with little success. He stated that at the Overbrook School for the Blind certain students are there who have been operated on unsuccessfully. At this institution there is quite a group of students with buphthalmos manifesting all of the phases seen in the advanced stages. Not infrequently cases are seen where the tension is + in one eye and − in the other, and the eye becoming atrophic.

Dr. Holloway said he would appreciate the opinion of any of the members of the Section as to what operative procedure he would regard as best adapted to these cases or to this particular case. They had seen her through two attacks, one acute and one sub-

acute, and it was expected that she would ultimately be seen at the Overbrook School.

Discussion. Dr. deSchweinitz said that although buphthalmos is usually described as a bilateral affection, certainly in its earlier stages it is not uncommonly unilateral; witness T. R. Aynsley's recent interesting communication (*Brit. J. Ophth.*, December, 1929) on "Buphthalmos and Nevus," where 10 cases of unilateral buphthalmos are listed, 6 of the right eye, 4 of the left eye. All of these patients were mentally defective, and gave evidence of cerebral lesion, usually calcified meningeal nevus.

Dr. deSchweinitz referred briefly to girl twins, normal in all respects until the age of six and a half months, when, after a short, ill-defined illness, left buphthalmos began to develop, in the form of enlargement of the globe, very hazy cornea and increased intraocular tension, which yielded temporarily to miotic treatment. The examinations were made some months ago, and he had received no information as to the present condition of these children.

Referring to the operative treatment, Dr. deSchweinitz stated that his best operative results, at least temporarily, had followed repeated posterior sclerotomies, as advocated by Haab, and this had been, he believed, the experience of his associate, Dr. Baer. He doubted the value of iridectomy; he had seen two satisfactory results from corneoscleral trephining, the operations having been performed by colleagues, but he did not know whether these results had been permanent.

Dr. Zentmayer said that, some years ago, in preparing a paper on buphthalmos, he had sent out a questionnaire to most of the prominent eye surgeons in the country regarding the proper procedure in the treatment of this condition. One surgeon, with a large experience in Philadelphia, stated that the only operation was enucleation. Dr. Weeks advocated trephining, which was then a comparatively new operation. Dr. deSchweinitz suggested the procedure of Haab, of repeated posterior sclerotomy. Gifford subsequently did a number of trephining operations with unsatisfactory results. His explanation of the reason one did not get filtration in these cases was that the conjunctiva was held close to the sclera because of the distention of the globe.

Dr. Zentmayer said that his own experience had been very unfavorable with operation. He recalled the case of a little child, an infant, who had very marked buphthalmos, on whom he did an iridectomy. Most of the contents of the eye were expelled through the incision in the globe. Dr. Posey attempted cyclodialysis upon the other eye of the patient, but failed.

Dr. Zentmayer referred to a case which Dr. Peter showed before the Section, a few years ago, in which he had done an iridectomy with very successful results in a beginning buphthalmos.

Dr. Zentmayer felt that repeated posterior sclerotomy was the only safe operative procedure, but the results are not satisfactory.

Dr. Baer said that he agreed with Dr. deSchweinitz with reference to posterior sclerotomy as being the best operative treatment in these cases, but his own feeling was that this only delays the inevitable.

Dr. Chance recalled the case of a little colored child, just two years of age, who had been under observation in his ward two years ago. He did a sclerotomy upon her with very satisfactory results. The child had been away from the hospital for many months, but returned that day, and he was greatly distressed to see that a great change had taken place and to note that the eye looked very much like that gleaming gem called cat's eye. The corneas were very edematous and the general discoloration of the sclera ringlike. He was very much disappointed because the immediate results had been so good.

Dr. Holloway, in closing, said he wished to thank the gentlemen who had expressed opinions as to treatment of this condition, and that he must confess that it is pleasing to be agreed with and that he shall eventually have this child as a patient at the Overbrook School for the Blind. If the present treatment does not give satisfactory results, posterior sclerotomy probably will be resorted to.

He said that some may remember that Dr. Gifford reported the history of a case where the sclera was trephined and a posterior sclerotomy was performed through the trephine opening. About six months before that case was recorded, a patient was sent to the University Hospital on the service of Dr. deSchweinitz. The chamber was so shallow that it was absolutely impossible to get any kind of an instrument into it. Trephining of the sclera was done and a puncture made through the opening, hoping to get some deepening of the anterior chamber. At the end of forty-eight hours the tension was as high as before operation.

Dr. Holloway said that of all operative procedures he thought that posterior sclerotomy probably offered the most, chiefly because it can be readily repeated.

Operative Treatment of Pulsating Exophthalmos

Dr. G. M. Dorrance (by invitation) read a paper on a new operation for the treatment of pulsating exophthalmos, which was devised because of the failure to cure cases by ligation of the common carotid alone, and because of the danger of hemiplegia occurring where ligation of the internal carotid was practised. The observations of the following facts on a patient in whom he had ligated the common carotid led to the method he now advocates.

On reoperating upon this patient to determine why the ligation of the common carotid failed to cure the exophthalmos, I found pulsations present in both the internal and external carotids, this, of course, being due to collateral anastomosis between the two external carotids.

I placed a clamp on the internal, the external and the ascending pharyngeal arteries.

If the clamp on the external was released and the blood pressed out of the vessels in the areas lying between the ligature on the common carotid and the clamps on the vessels above enumerated and the clamp reapplied, this space remained empty.

If the clamps on the internal carotid were released, the space would slowly fill up with blood. This blood was then pressed out of the space and the clamp reapplied.

If we released the clamp on the external carotid the space would quickly refill; the same was true if we released the clamp on the ascending pharyngeal, but the influx was naturally much slower.

These observations convinced me that, after ligation of the common carotid, the internal carotid becomes a branch of the external. With these facts in mind, the following operation was advocated:

The common carotid (under local anesthesia) is ligated. Ten to fourteen days later the following branches of the external are ligated, either one or more at the second sitting, dependent on the amount of arteriosclerosis present: the superior thyroid, the lingual, the facial, the ascending pharyngeal and the occipital.

In the case shown, an excellent result was obtained.

Discussion. Dr. Holloway stated that Dr. Dorrance had been good enough to permit him to see this patient some weeks ago. He felt that all were familiar with the various combinations that have been resorted to in the ligation operations and that slow ligation has been a distinct advance.

He said that while it was true that the superior thyroid has been ligated in conjunction with the carotid, he knew of no instance where the various branches have been so treated and where the possibilities for such splendid control have been demonstrated. He said he thought Dr. Dorrance was to be congratulated on his ingenious technic and his excellent result.

As he had repeatedly said before, he felt that the incidence in pulsating exophthalmos for carotid ligation is quite well established, it is approximately 8 per cent. However, he had never felt satisfied that the statistics concerning cerebral complications following carotid ligation were reliable, and that this was one of the reasons why he had never been in accord with those who have been so apprehensive about the orbital operation. Further, those same individuals have no hesitancy about an exenteration of the orbit, where these same structures are severed at the very apex of the orbit and much closer to the cavernous sinus than would be the case where ligation was resorted to.

Do Corneal Scars Move? A Preliminary Report of a Clinical and Biochemical Study

Dr. Ben. Witt Key (by invitation) described the character of the corneal scar which may shift its position in corneal substance. This is the newly formed scar, or one recently cicatrized, of the slanting-cut variety or irregular laceration type (so-called linear scar), located in the superficial or deep substance of the cornea and involving the pupillary area just below the horizontal median line. Cases were cited indicating a shifting of the scar's position downward and toward the limbus after a period of one to four years. Measurements as to the size and location of the scar in order to avoid errors in observation were noted in detail in the attempt to determine definitely its corneal change. The extent of this change is admitted to be very limited, not more than 1½ to 2 mm., but when viewed in comparison with its area of location (the lower half of the pupillary area) it represents a change of some significance.

A brief of the more recent studies of wound healing and regeneration of the cornea, the formation of a corneal cicatrix and the interpretation of these cellular changes was presented. An analysis of the physical and chemical influences which may explain the shifting of a scar's position was offered. It was suggested that the anatomic structure of the cornea with its biochemic activity (demonstrated under the microscope and by experiment), its migratory cellular content, its fluid composition (about 90 per cent of its volume is water), may permit this change to occur in time through fibrous contraction, tissue tension, pressure exertion of the lids and possibly through functional stimulus induced by adjoining structures or by the action of sunlight.

Subconjunctival Injection of Pregl's Solution in the Treatment of Gonorrheal Ophthalmia

Dr. Alfred Cowan and (by invitation) Dr. Searle H. Lanyon reported a series of 6 cases of gonorrheal ophthalmia in adults treated by subconjunctival injections of Pregl's solution. Fifteen minims of the solution were injected under the highest point of the

chemotic bulbar conjunctiva, every day, as long as the laboratory report showed the presence of gonococci.

The duration of the infection for the six cases treated was, respectively, thirteen, six, five, three, seven and five days, an average of six and five-tenths days. Case V, given as of seven days' duration, was practically free of organisms in three days, only a few gonococci having been found on the sixth and seventh days.

In only 1 of the eyes was useful vision lost. This was in a man, aged seventy-three years, whose cornea was already nearly opaque on admission. In 4 of the cases the vision was unaffected, and in 1 the vision was 6/12.

One other feature should be considered in this series; in no instance was more than one eye involved. This, of course, must be credited to good nursing and careful prophylaxis. Whether or not the treatment had any bearing on this cannot be said.

PROCEEDINGS

OF THE

SECTION ON OTOLOGY AND LARYNGOLOGY

JANUARY, 16

Bronchoscopy and Disease: A Brief Résumé

Dr. Chevalier Jackson gave a brief résumé of cases observed in the bronchoscopic clinics of Philadelphia during the four months, ending December 31, 1928. Of the total number of cases (6938), 4339 were consultations, 353 direct laryngoscopy, 1643 bronchoscopy, 10 tracheotomy and 391 esophagoscopy.

During the four months ending December 31, 1923, there were 445 total cases for examination, 88 per cent for disease and 51 cases for foreign body, while during the last four months of 1928 only 112 cases of foreign body (2 per cent of the total) were treated and 6826 cases were referred because of disease. Treatment in foreign-body cases was successful in 98 to 99 per cent of the patients.

Details of a case of pulmonary suppuration were presented, showing how aspiration of the pus was followed by recovery. Dr. Jackson predicted that in twenty-five years every pulmonary disease will be treated by means of the bronchoscope.

Laryngeal Stenosis, with Special Reference to Methods of Treatment and Results

Following a brief discussion of stenosis and its treatment, Dr. Gabriel Tucker exhibited slides of a number of cases which had required dilatation with various sizes of dilators by the direct method. The method of dilatation by means of plugs was described. When other methods fail, laryngoscopy can be done, excising the cicatricial tissue and using dilators. The use of laryngoscopy instruments and the results of such treatment were illustrated by lantern slides.

Tuberculosis of the Bronchial Wall

Dr. Louis H. Clerf pointed out that bronchoscopy is rarely justified in a known case of tuberculosis, but occasionally might be indicated in the treatment of cicatricial stenosis secondary to a healed perichondritis or suppurating peritracheobronchial lymphadenitis of tuberculous origin.

The case of a man, aged thirty-two years, was presented. Beginning with acute coryza and an unproductive cough, there later developed wheezing and fever. The patient could only lie on his right side. The physical signs were inexplicable. The *x*-ray demonstrated the right diaphragm always higher than the left and the left lung changing little during the breathing cycle. There was a definite increase in the size and density of the root shadows at the root of the left lung. The history had no bearing on the present illness. There had been no hemoptysis and the sputum was negative for tubercle bacilli. The Wassermann and Kahn tests were negative.

At bronchoscopy, the orifice of the left bronchus was negative, but at a point 2 cm. beyond the carina there was observed an area of superficial erosions of the mucosa covered with a grayish exudate involving the outer wall and extending along the anterior and posterior walls; this extended downward along the bronchial wall, and, at the orifice of the upper-lobe bronchus, there were found small, flat, pale fungations which partially occluded its lumen. The mucosa of the lower lobe bronchus was infiltrated throughout its entire extent and, at a point about 1 cm. beyond the upper-lobe orifice, the lower lobe bronchus was occluded by inflammatory tissue, so that its lumen existed as a mere slit with its long axis lying in the coronal plane. A specimen of secretion and a small fragment of tissue were found to contain the human strain of tubercle bacilli. No attempt was made to carry out topical applications and bronchoscopic dilatation was not practised.

Post-tonsillectomic Abscess of the Lung: Bronchoscopy in Diagnosis and Treatment

Dr. Robert M. Lukens, in reviewing the literature, pointed out that Clerf had found the greatest number of cases (39+ per cent) between the ages of twenty and thirty years, as compared with

10+ per cent in children ten years of age or under. He discussed the relative importance of choice of anesthesia, position of the patient during operation and age. Pulmonary abscesses should be suspected in every case with pulmonary symptoms following tonsillectomy. Diagnostic bronchoscopy reveals the exact lobe in which the abscess is located, and in the case of lower-lobe abscesses the location can be narrowed down to the area drained by a subdivision of the lower-lobe bronchus. The possibility of peroral drainage can also be determined at this time.

A case was presented illustrating the fact that a foreign body, such as bone, too thin to be opaque to the *x*-ray, may be the obstruction even in a case of pulmonary abscess following tonsillectomy. The patient had inhaled a small piece of bone when an intranasal operation was performed at the same time as the tonsillectomy.

Hysterical Aphonia: Disappearance Following a Diagnostic Bronchoscopy

Dr. William F. Moore presented the case of a female, aged thirty-five years, in which there was a history of periodic loss of voice over a period of six years. The attack usually followed exposure to cold or getting the feet wet. The cords were thickened, but came together on coughing. The case was followed over a period of five months, during which local medication and electrical stimulation were tried without result. Because of the lack of improvement and the patient's sense of constriction, diagnostic bronchoscopy was performed. The bronchoscopy was negative, but the next day the patient had lost all symptoms.

The majority of cases reported have been in women of the neurotic type during menstrual life. There may be a functional adductor paresis, which is usually complete. That this is functional is shown by the mobility of the cords during coughing or laughing. The usual signs of an acute laryngitis are not found.

The Aorta in Relation to Esophagoscopy

Dr. J. Sanford Moyer reviewed the anatomical relation of the aorta to the esophagus. Esophagoscopy under proper precautions is without danger to the aorta normally. In disease the dilated aorta is always in danger. Esophagoscopy is justifiable in the case

of foreign body, and with care may be done even in the presence of aneurysm. Three cases were presented illustrating stenosis the result of aneurysm and stenosis not associated with aneurysm.

Asthmatic Symptoms Due to Granulomata of Both Main Bronchial Orifices Complicated by Cicatricial Stenosis of the Left Main Bronchus: Disappearance of Symptoms after Bronchoscopic Removal of Granulomata and Bronchoscopic Dilatation of Stricture.

Dr. Edmond Aucoin presented the case of a woman, aged thirty-nine years, in which shortness of breath, wheezing respiration, paroxysmal cough, intermittent expectoration of pus (at times blood-streaked), loss of weight and extreme nervousness were the prominent symptoms. Beginning ten years before, the symptoms had become progressively worse and the patient had been treated over a period of four years for bronchial asthma. Later, a diagnosis of tuberculosis was made, but no acid-fast organisms were ever found. Physical and roentgen-ray examinations were absolutely inconclusive.

On bronchoscopy, a large pedunculated mass in the right main bronchial orifice was found to move up and down with bronchial movements. Fungations sprang from the outer and posterior wall opposite the carina and partially occluded the left main bronchial orifice. Following the removal of the pedunculated mass, the patient could breathe freely and feel air go in and out on the right side. Laboratory studies on the secretions and tissues were negative for tuberculosis and spirochetal and parasitic infections; histological examination revealed only lesions of a chronic inflammatory type.

Two bronchoscopies were sufficient to clear up the granulomatous condition, which had not recurred a year later, and even during and after an acute upper respiratory infection there was no recurrence of cough, wheeze or dyspnea.

Bones as Overlooked Foreign Bodies in the Lung.

Dr. C. L. Jackson pointed out that bones represented 13 per cent of the foreign-body collection brought together by Dr. Chevalier Jackson. Of these, 15 per cent had been retrieved from the air passages and 85 per cent from the food passages; 10 per cent of

foreign bodies are overlooked and 20 per cent of the bone specimens were in the overlooked class.

A number of cases were discussed and lantern slides of the roentgen-ray plates and specimens were shown. In 8 typical cases of overlooked bone in the lung, only 2 showed the foreign body in the *x*-ray plates and 2 cases had a completely negative history. In another case, a year after the patient had choked while eating squirrel, an abscess developed in the left lower lobe and there was obstruction of the left bronchus. The *x*-ray showed no foreign body, but at bronchoscopy Dr. Tucker removed three vertebræ of the squirrel.

The possibility of foreign body should be considered in all cases of chronic pulmonary disease with or without a suspicious history and whether the *x*-ray shows the foreign body or not.

Lantern-slide and Moving-picture Demonstration of the Jackson Technique of Bronchoscopic Aspiration

The films, taken at the Bronchoscopic Clinic of the University of Pennsylvania Hospital, showed the details of routine bronchoscopic aspiration as carried out on outpatients. The rapidity of the procedure and the indifference of the patients to the operation, both before and after treatment, were noteworthy.

FEBRUARY 20

Chondritis and Perichondritis of the Larynx, with Report of a Case

Dr. Robert F. Ridpath, after outlining the salient features of the etiology, differential diagnosis and therapy of acute and chronic chondritis and perichondritis, presented the case of a woman, aged forty-four years, coming under observation three weeks after hoarseness had developed. Two days before admission to the hospital there had been complete loss of voice, and during the night the patient was awakened by the inability to breathe normally, due to pus in the throat; swelling of the neck, more marked on the right, was noted the following morning. Marked dyspnea, expectoration and painful deglutition ensued. There was a history of three attacks of peritonsillar abscess.

Bacteriological studies were negative for pneumococci and tubercle bacilli and the foreign-body examination was negative. A subnormal temperature, with a pulse of 120 to 150 and respirations of 40, was recorded, but the respirations dropped to 20 to 25 following local treatment. Because of dyspnea and mucus, examination of the larynx was impossible at first, necessitating a policy of watchful waiting. Hot compresses over the neck, inhalations of benzoin, atropine sulphate and digitalin were used.

After two days the laryngeal mirror revealed a swollen pyriform sinus on the right, with a congested larynx, and the cords could not be seen. Oil of chaulmoogra was injected into the larynx daily. On the ninth day, the abscess having localized, an incision was made through the skin to the cricoid cartilage and thence through the perichondrium of the cricoid. The wound was allowed to heal and recovery was complete. Former peritonsillar attacks, enabling microörganisms to burrow through the cervical tissues into the larynx, were concluded to have been the cause of the process.

Discussion. Dr. George M. Coates: The cases with most marked perichondritis and necrosis of cartilage that I have seen were secondary to radium and x-ray, applied from the outside in the treatment of cancer of the larynx.

Dr. Fielding O. Lewis: I have seen two children with perichondritis, following influenza, who recovered after tracheotomy. In one case, that of a basket-ball player, the process followed the striking of the larynx against a platform. In another case the cartilage sloughed out after laryngofissure following electrocoagulation of a carcinomatous growth. In acute cases, following any acute infection, the larynx should be put to rest by tracheotomy to prevent chronic laryngeal stenosis.

Dr. James A. Babbitt: A case coming under my observation followed excessive use of the stomach tube. The arytenoid cartilages sloughed out, but the voice was not bad after recovery. Metastases from a malignant tumor eventually proved fatal.

Lateral Sinus Thrombosis, with Report of Two Cases

Dr. Edward H. Campbell presented two cases: The first case, a female, aged nineteen years, had been treated at home for typhoid and tuberculosis for three weeks before admission. There was low abdominal pain and vomiting, with cough and expectoration. The ear was not painful, but there was a swelling below the angle of the right jaw. Both drums were absent, but no bulging of the canal walls had occurred. The Widal and acid-fast studies were negative.

The leukocytes numberd 25,800. The cranial nerves, other than the eighth, were negative. Choked disks with hemorrhages and exudate about the disks were noted.

At operation, a clot in the lateral sinus was found to extend as far as the torcular herophili. The internal jugular vein was ligated and counter-openings were made in the neck. Continued high temperature raised the question whether extension had occurred to the opposite lateral sinus. A carbuncle on the shoulder, an abscess on the buttocks and a clouding of both bases in the chest *x*-ray explained the symptoms. Autopsy was not obtained.

The second case presented was that of a female, aged eight years. The drum had been incised following an attack of mumps, but a purulent discharge and fever continued. A typical hemorrhagic mastoiditis ensued, with thrombosis of the lateral sinus by way of the emissary veins and septicemia. There was little tenderness over the mastoid. Excessive bleeding was encountered in the mastoid area at operation. Meningitis of a serous type developed. Metastatic abscesses, one subpectoral and the other of the left labium majus, were drained. Hemolytic streptococci were found in the blood cultures. Complete recovery followed, largely due to repeated blood transfusions and to the fact that the metastatic abscesses were accessible for drainage. In both cases the Tobey-Queckenstedt test was found of considerable value.

Discussion. Dr. James A. Babbitt: I would like to raise the question, What would have happened to the patient if both internal jugulars had been tied?

Dr. Nathan P. Stauffer: Familiarity with the technique of lumbar puncture and the Tobey test are necessary for success. Pressure on the opposite vein must be correctly done. Many cases recover if transfused who would otherwise die. Both jugulars may be tied and collateral circulation obtained.

Dr. Philip Stout: The internal jugular vein should be tied off before opening the lateral sinus, so as to prevent the infectious material getting into the circulation. Cases should be hospitalized early.

Dr. George M. Coates: Dr. Hastings reported a case in which, within an interval of a few days, both internal jugulars were tied without untoward effect. Previously bilateral ligation had been reported three times, but not all of these were for sinus thrombosis. In two cases of jugular bulb thrombosis I have seen the temperature dropped to normal in a few days in the case tied off and remained up in the case not tied.

Dr. Campbell, in closing, said that the main precaution in taking a Tobey record is keeping the patient quiet, even if a mild anesthetic is given.

Comparing the Different Points of Technique of the Modified Lothrop with the Killian Operation for Chronic Frontal Sinusitis (Lantern Demonstration)

Dr. Samuel R. Skillern regards the modified Lothrop procedure as preferable because it requires less operating time and anesthesia and produces less shock. Constant pressure on the orbit during the Killian operation results in edema of the eyelids and danger to the optic nerve, while there is ever danger of injury to the lacrymal duct, and septal cells as well as small supraorbital cells may be overlooked. Fistulous formations around the inner angle are apt to occur after the Killian operation. Diplopia is never a worry in the Lothrop operation. Blindness on the operated side occurs, due to injury of the optic nerve, when working on the ethmoids. A small scar in the hairline and no disturbance to the eye recommend the Lothrop procedure.

Details of both operations were illustrated by lantern slides. In suspected double frontal sinusitis the Skillern technique is to break through the interfrontal septum. If the other septum is found diseased it is curetted through the sinus first opened. All diseased tissue must be removed to get results.

Discussion. Dr. Robert F. Ridpath said that the Killian operation is difficult and followed by much deformity. The granulation forming afterward often defeats the purpose of the operation. The modified Lothorp operation has many advantages over the Killian when it can be performed, *i. e.*, when no necrosis or death of bone exists on the superior orbital plate. If dead spicules of bone exist, then the Killian operation is resorted to. If the skin is raised first, and then the tissues and periosteum, little if any deformity results. Chiseling of bone following the use of the frontal rasp is not always necessary; the rasp is often quite enough. The application of bandage saturated in vaseline, as an after-treatment, keeps the skin pliable and moist, is antiseptic and prevents large, ugly scars.

Dr. Nathan P. Stauffer: The deformity in the Killian operation is due to removal of the external plate. I prefer the Knapp or modified Knapp operation. By taking away the entire floor of the frontal sinus no deformity results because the anterior plate is intact. Rasping may be done upward instead of downward. Filling-in by orbital fat aids in preventing deformity. I always leave a wick in and have had no fistulas resulting. In two cases diplopia occurred, but disappeared after a year.

Dr. Walter Cariss: Removal of the orbital plate is satisfactory and there is no scarring. The Knapp operation is better than the Lothrop and there is less resulting deformity.

Dr. George M. Coates: I wish Dr. Skillern would point out what con-

stitutes the modification of the modified Lothrop operation. My main objection to the Killian operation is the bleeding. The original Killian operation was devised for chronic pansinusitis as well as chronic frontal sinusitis. The modified Lothrop procedure does not take care of such a condition. The scheme of sewing the periosteum and soft parts over the opening and then replacing the skin prevents much deformity.

Dr. Skillern, in closing, stated that his objection to the Knapp operation is that you cannot see in the sinus, and may miss a septal cell or a large supraorbital cell. By going in above, a clear view of everything is obtained. The Knapp operation is satisfactory in the case of a small frontal sinus. There is no deformity if the edge of the periosteum is sewed to periosteal edge. Complete regeneration of bone $\frac{1}{8}$ inch thick showed in 5 cases by x-ray. In one case Dr. Ross H. Skillern picked up the cut edge of the superior oblique and sewed it to the ridge to prevent diplopia.

The Lothrop operation is entirely intranasal. Following the removal of the anterior tip of the middle turbinate, dental drills were used to drill upward. A supraorbital incision was made and the interfrontal septum and nasal septum cut away.

The modified Lothrop operation consists of two stages: First, the anterior tip of the middle turbinate is removed and the frontal duct rasped out. The second stage consists of the external operation. There is no need to fear breaking into a normal sinus from an infected sinus. Granulation closure of the ostium results, but no infection ensues, and the patient does well. It is a good procedure to break through the intersinus septum in order to get aëration by way of the good sinus.

MARCH 20

Mastoid Infection Following Furunculosis of the External Auditory Canal, with Presentation of Patient

Dr. E. B. Gleason said that an attack of acute tonsillitis was followed a week later by discharge from both ears, and four weeks later by swelling over the left mastoid area. The left external auditory canal was completely occluded by swelling, so that the tympanic membrane could not be viewed. Apparently, furunculosis was the result of a scanty discharge in the external canal and infection extended to the mastoid by way of the soft tissues or by the usual route.

At operation the mastoid incision delivered 1 dram of pus and a probe introduced into the canal released a quantity of pus. The mastoid cells were completely obliterated and the lateral sinus covered by granulations but not thrombosed. Recovery was unevent-

ful, and this is the usual course if healthy or unhealthy granulations are left undisturbed. Those over infected clots should be removed at the first operation.

Ludwig's Angina. Case Report. (Lantern Demonstration)

Dr. George Fetterolf and Dr. Karl M. Houser. Dr. Fetterolf defined Ludwig's angina as a phlegmon in the floor of the mouth above the mylohyoid muscle. In reviewing the major anatomic features of the sublingual space, it was pointed out that this space is bounded at the front and sides by the mandible, below by the mylohyoid muscle, additionally supported on the outside by the anterior belly of the digastrics and the deep cervical fascia and on the inside by the geniohyoids, above by the tongue and the mucosa of the floor of the mouth, behind by the deep part of the submaxillary salivary gland, the hyoglossus muscle, the styloglossus muscle, a strong band of fascia extending mesially from the inner part of the submaxillary gland to the side of the tongue. The posterior and superior boundaries afford the least resistance and inflammatory conditions extend in these directions. The buccopharyngeal opening affords a gap through which sublingual infections extend into the tissues of the neck. The submaxillary gland is of particular interest in that it lies partly within and partly without the sublingual space.

The abscess may be lateral to, below or above the geniohyoid. The latter type is most difficult to reach from the outside. Surgical treatment consists in first locating the abscess, whether on one side or the other or diffused. If a hard, firm mass is felt in the floor of the mouth a short incision is made in the mucous membrane and a hemostat or grooved director passed downward and backward. The incision must be small, not too far back and made under observation. A possible argument in favor of an internal incision is that in a series of 106 cases, collected by Thomas, there were 17 of spontaneous rupture of the abscess, and all 17 were on the inside.

When internal incision fails an external incision is made, either lateral or median. The mylohyoid muscle must be penetrated and the suspected area explored as far as the buccal mucous membrane. Exploration backward toward the deep part of the submaxillary gland is always done. If no pus is found the explored area should be drained with tubes, not gauze, as pus may not appear for one or more days after exploration. Since most deaths in Ludwig's angina

are due to edema of the larynx, tracheotomy is recommended as an early procedure.

Four cases were discussed, one of which, that of an adult male, was the basis of the report. Moderate swelling and slight tenderness of the submaxillary and anterior cervical glands of the right side were followed by marked dysphagia and swelling of the tongue and floor of the mouth, more pronounced on the right side. Laryngeal edema without dyspnea appeared. An incision in the area of greatest swelling was followed by a gush of pus. The patient was discharged from the hospital forty-eight hours later and within a week all parts were practically normal.

Ludwig's Angina: A Case Report

Dr. George B. Wood stated that the patient had had three or more attacks of infection of the right submaxillary gland, with swelling suggesting a ranula. The attacks disappeared after two or three days. Finally, a similar attack was followed by extension of the swelling forward under the chin, and the floor of the mouth became hard and boardlike.

An incision from the outside released 2 drams of foul-smelling pus. The wound was packed and a drainage tube introduced. For eight to ten hours after operation the patient did poorly and forcible depression and holding forward of the tongue was necessary to obtain breathing. Pus drained from the wound for ten days. Saliva continued to drain, and when the fistula closed a ranula developed; later the duct was opened and the wound closed without getting a salivary fistula or ranula.

Discussion. Dr. Philip Stout: A case which I saw twenty years ago had marked mental symptoms. The patient left the hospital in midwinter clad in a sheet and later disappeared from home. Spontaneous rupture and recovery followed.

Dr. George B. Wood: In stating the reasons for opening from the outside the case discussed, I neglected to mention that the extreme swelling on the side made it seem best to ascertain whether the process had passed the attachment of the superior constrictor muscle and was extending down the neck.

Dr. Robert Hunter: It is difficult to locate the abscess in the mouth. External or internal opening depend on the location of the swelling and existence of laryngeal edema. External incision relieves tension and decompresses the abscess. Cellulitis is often a big factor and little pus is found.

Internal incision is best where pus is not found. The cases I have opened were incised in the median line.

Dr. George M. Coates: Of 8 cases I have seen, several occurred from dental caries and 1 followed mastoiditis. I have searched for the abscess four or five times without finding more than a few drops of pus in any one location. The pus was always very foul-smelling. Carious teeth are the commonest cause, but some undoubtedly have a tonsillar origin, and 1 case recovered following drainage of a peritonsillar abscess. All the cases I mention got well.

Dr. George Fetterolf: Digital examination between the gum and the tongue demonstrates the difference on the two sides. Where digital examination shows hardness in the floor of the mouth localization is assured.

Dr. Samuel Skillern: Is there any objection to through-and-through drainage? I saw one case clear up in twenty-four hours following such drainage.

Dr. Fetterolf, in closing: If we go in from the outside and get drainage, there is no need for internal incision. Pus obtained from internal incision makes external incision superfluous.

Report of Two Interesting Foreign-body Cases in Nose and Mastoid

Dr. Edwin P. Longaker stated that the first case was that of a boy, aged eleven years, who had placed a glass button in the ear five years before admission. Repeated efforts at removal failed and the *x*-ray failed to show the foreign body. The ear discharged for two years. A swelling behind the ear had been several times incised and pus obtained. There was fluctuation of the posterior canal and the membrana tympani had a perforation.

The usual mastoid incision opened a large superficial collection of pus extending above and in front of the auricle, connecting with a fluctuant mass in the posterior canal. A tract parallel to and behind the external canal was exposed and a ball of cotton the size of a pea removed. At the bottom of the tract and at the level of the tympanic membrane was a piece of glass the size of a split pea. Facial twitching followed attempts at its removal. The wound healed in two weeks, and after six weeks the canal remained dry. Impairment of hearing continued.

The second case, that of a boy, aged five years, was admitted with bleeding from the right nostril. The boy had placed a Fourth-of-July "snake" in the nostril five days earlier. Previous attempts at removal had failed. An abscess of the hard palate formed and was incised. There was tenderness over the right maxillary sinus.

The foreign body was tightly wedged between the right inferior turbinate and the septum. Necrotic bone on the floor of the nose was curetted. Soft and friable portions of the inferior and middle turbinates were removed and the maxillary sinus irrigated free of purulent material. Recovery followed.

Anesthesia is imperative for success in the removal of foreign bodies, since the most frequent cause of failure is the struggling of the frightened child. The glass button in the ear was very likely broken in the early attempts to locate it and was pushed through the tympanic membrane to lie in the region of the facial nerve. Prompt *x*-ray and anesthesia would have prevented the acute sinusitis and necrosis in the second case.

Discussion. Dr. Robert Ridpath: Anesthesia is advisable in removing foreign bodies from almost inaccessible locations. The ulceration following the insertion of phosphorus- and potash-containing compounds must be considered.

Dr. George Fetterolf: A point in technique worth mentioning was carried out in removing a cherrystone from a child's ear. A hole was burned into the stone with a cautery and a screw instrument introduced in the hole. Removal was then readily accomplished.

Dr. Thomas Currie: Of the many foreign bodies I have seen, some of the cases being mutilated before coming under observation, all were removed with a syringe and hot water.

APRIL 17

Brain Abscess

Dr. Francis C. Grant said that the extent of infection depends entirely on the ability of the surrounding tissue to wall it off, and the result of the protective reaction is the formation of a capsule about the abscess. The two most important factors for a successful result are the presence of adhesions obliterating the subarachnoid space and the degree of encapsulation about the infectious process.

Dr. Grant considers the mortality statistics in his series discouraging, but obtains satisfaction from the fact that a diagnosis of brain abscesses was made in 26 of the 30 cases reported. The abscess was found and drained in the designated area in each of the 26 cases. The relatively high percentage of correct localization of the brain

lesion was due mainly to careful neurological investigation and exacting history taking.

In 27 of the 30 cases the point of infection was obvious. The question was not whether an abscess was forming, but rather what the position of the abscess was. Intracranial tension is increased and in 24 out of 26 patients edema of the optic disks was noted. In 16 among 30 patients a lumbar puncture was made, and in 14 the pressure was recorded as increased. A cell count of the spinal fluid is important from the surgical standpoint. Operation is useless in the presence of an incipient or frank meningitis. The lower the cell count the better the chance that the abscess is walled off. Bárány tests were only employed on three occasions. In each instance these tests confirmed the diagnosis.

The patients are lethargic, less coöperative and sicker than might be expected; the pulse-rate and respiratory-rate are slower and the temperature lower. The pulse-rate and respiratory-rate should be taken hourly to detect cycles of depression. It is less difficult to determine the presence of the lesion than to drain it and save the patient's life.

Operation is not imperative simply because the diagnosis of brain abscess has been made. When to operate is more important than where to operate. To operate during the stage of spreading cerebritis, before the septic focus has become encapsulated, is fatal. On the other hand, while we procrastinate, the infection may break into the ventricles or the subarachnoid space, producing a fatal meningitis. How are we to know when localization is complete?

The causes of abscess in the 30 cases Dr. Grant presented were as follows: Otitis media, 12 (temporal lobe, 7; parietal lobe, 1; cerebellar lobe, 4); frontal sinus, 11; injury, 4 (occipital lobe, 1; frontal lobe, 1; temporoparietal lobe, 2); pulmonary infection, 3 (frontal lobe, 2; temporal lobe, 1). Of the 30 patients, 26 were male and 4 female. The causes of death were: Meningitis, 11; cerebritis, 7; pressure, 2; pneumonia, 2. The time of development of the encapsulated cases averaged sixteen weeks, while that of the unencapsulated cases averaged five weeks.

Discussion. Dr. W. J. Gardner reported two cases of metastatic abscesses of pulmonary origin in which the sequence of events was similar, namely, tonsillectomy, lung abscess and brain abscess, with recovery in the case of solitary abscess and death in the case of the multiple abscess. Both cases developed brain abscesses while under observation. The case of

solitary abscess was characterized by a subnormal temperature and pulse-rate and a normal leukocyte count, even in the presence of a suppurating pulmonary lesion which had previously caused fever and leukocytosis. The onset in the case of multiple brain abscesses was apoplectiform and in the case of the solitary abscess it was insidious. Both cases were operated upon. At autopsy, the multiple-abscess case showed a meningitis of five or six days' duration and abscesses in each parietal area (one in the right frontoparietal area and one in the left temporoparietal area) and abscesses in each occipital lobe.

Dr. B. Alexander Randall: In these cases the temperature may rise to 106° and a septic type of fever may be noted. In spite of the temperature elevation, the pulse-rate drops to 43 or 44. With the development of the abscess the pulse-rate falls to normal or subnormal, when we would expect a high pulse-rate, especially since these cases begin as a cerebritis and the intracranial pressure is not great. This slow pulse-rate is almost pathognomonic of brain abscess.

The Bárány test is an aid in localization, especially in ascertaining the presence of a subtentorial lesion. Cerebellar abscesses are usually very silent, even in the Bárány tests, and the gait is seldom demonstrable. The appearance of a curious, marked emaciation of the lower limbs in children with cerebellar abscesses aids the diagnosis. Projectile vomiting and other symptoms may lower the general nutrition, but in these patients the emaciation is almost entirely confined to the lower limbs.

The great majority of brain-abscess cases die of cerebritis or meningitis, which has been complicated by the surgeon. Irrigation disseminates the infection and may do serious mischief.

Dr. S. MacCuen Smith: Brain localization, insofar as abscesses are concerned, still leaves us in doubt, and at times in almost utter darkness, as to the exact locality of these formations, this notwithstanding the Bárány tests, which are at times very definite in the localization of intracranial tumors. In spite of this broad assertion, we are not quite without knowledge of some well-recognized diagnostic signs indicating the location of these abscess formations. Intracranial abscess, otitic in origin, most frequently occurs in chronic otorrhea and more particularly in those cases where cholesteatoma is present.

Given a case of suspected brain abscess without localizing symptoms, from the fact that the vast majority are located in the temporal lobe, this should be explored first and the abscess will usually be found quite superficial and just beyond the discolored tegmen antri or tegmen tympani. If, on the other hand, the cerebellum is involved, some evidence of the route of infection will frequently be discovered in the posterior mastoid cells. I have found during radical mastoid operations several cases of previously unsuspected temporosphenoidal abscesses which drained through a fistulous opening into the mastoid and tympanic cavities, the dura mater being walled off and firmly adherent to the underlying bone.

So long as the abscess involves the temporosphenoidal lobe of the right side the symptoms may be almost *nil;* but even though the abscess be very small, if located in the left temporosphenoidal lobe, various symptoms are

sure to develop, more especially certain abnormalities of speech. In temporosphenoidal abscess, when paralysis is present, it involves the opposite side, while in cerebellar abscess it is on the same side, as is also overpointing and rotary, nystagmus toward the affected side, this later becoming more marked as the disease develops. The development of optical aphasia in a patient suffering from a left chronic suppurative otitis media, especially if the patient is righthanded, is a reasonably certain indication of the presence of an abscess in the temporosphenoidal lobe.

Optic-nerve pathology is present more often in cerebellar abscess formations than in those in any other part of the brain. I have seen cases, however, in which these changes were not observable.

Slow pulse and respiration and low temperature are more common in cerebellar abscess; but, as these are the result of intracranial pressure, they may be quite marked from an abscess in any location provided it is sufficiently large to cause pressure.

Besides ataxic symptoms in cerebellar abscess, a very characteristic sign is the severe and almost constant headache. In the majority of my cases the vomiting has been projectile in type, but marked nausea was present in quite a few. Babinski's observation that pronation and supination are done with difficulty by the hand on the side of the lesion is a valuable contribution.

Acute abscess formations seldom form a capsule, whereas in the chronic type a capsule is to be expected in the presence of diplococcic infection, but less frequently when the streptococcic prevails. In some of my cases the evacuated pus has had a foul odor characteristic of colon bacillus infection, but I have been unable to demonstrate the presence of a capsule in these cases.

One excellent point, emphasized by Dr. Grant, is the delaying of operation until walling-off is complete. This facilitates the surgical procedure and provides additional safety for the patient. Delay enables the vessels to become sealed off and helps the prevention of septic dissemination by this route.

It has been my custom to evacuate otitic abscesses through the avenue of infection, following the method of Sir William Macewen, from whom I personally learned this technique. This route is more direct and necessarily favors drainage. In this respect I definitely disagree with Dr. Grant's technique. In the few cases in which I have followed the other route my patients died. I should like to ask Dr. Grant if he is familiar with the Mosher drain, as used by Tobey, of Boston, in his series of cases, which give the biggest percentage of cures, I believe, up to that time.

Dr. William H. Sears: In two cases of brain abscess I have observed the temperature and pulse and respiratory rates drop during obstruction to drainage. I would like to have Dr. Grant explain the mechanism of this phenomenon.

Dr. B. H. Shuster: Of 8 brain abscess cases I have had, 2 recovered. The fatal cases had complications such as sinus thrombosis with cortical abscess and 1 case developed tuberculous meningitis. The cases with internal dressings which were left in place five to seven days before removal

did well. Changing the external dressings is not so important, but they do not require frequent changing.

It is a question in my mind whether the time element has anything to do with operating. Should we wait for encapsulation? One case died with only a semblance of a limiting capsule, as shown by autopsy. I believe gentleness in handling the tissues more important than diagnosis.

Dr. T. H. Mooney: I would like to ask Dr. Smith whether any complications ever develop in puncturing through the infected area when an abscess is present?

Dr. S. MacCuen Smith: We never make such explorations unless we are reasonably certain that we have an abscess. I do not recall that any complications ever followed.

Dr. Grant, in closing: I agree with Dr. Smith that when the presence of an abscess is certain it should be approached through the infected field because this approach is somewhat walled off. When the lesion is on the right side and there is considerable doubt of the presence of an abscess, I have a horror of going through a clean field. The proper method is to go through the infected field, but I often fear doing this because of the possibility of carrying infection into an uninfected area.

I do not know the explanation of the slow pulse-rate, slow respiration and mental lethargy. We do not get these symptoms in tumors, and their presence certainly turns the attention to the possibility of abscess. Concerning the question of collapse occurring before the capsule is complete, I believe that pressure collapse is not infection; but if collapse occurs, then we must tap just as soon as possible.

Dr. Shuster's point is important. Neurosurgical opinion is behind me when I say wait for encapsulation; but I do not know what the neuro-otological view usually is. Occasionally, when we wait long enough, the abscess and the capsule may be removed in one piece. By waiting, the microörganisms become attenuated and when drainage is done the remaining bacteria are less likely to be vicious.

OCTOBER 18

Some Problems in Otorhinolaryngology

By HERBERT TILLEY, B.S. (Lond.), F.R.C.S. (Eng.)
SENIOR SURGEON, ROYAL EAR AND THROAT HOSPITAL (UNIVERSITY COLLEGE HOSPITAL) LONDON

It would be difficult for me to describe how keenly I appreciate the honor of being the guest of your Section this evening and of having been invited to address an audience which contains so many names distinguished in our particular branch of medicine. The task of preparation has been hard, and would have been still more

difficult had you not given me permission to ramble where fancy might lead me, even if this should involve some retrospects of a pilgrimage of nearly thirty-five years.

In the early days of that period I saw and, I hope, shared in the successful struggle for the recognition of diseases of the ear, nose and throat as a special department of medicine, and for its being placed on an equal footing with obstetrics, psychiatry and those other branches of our art and craft which require special and prolonged training. Today practically every large hospital in Great Britain has its ear and throat department, and many of the smaller hospitals in country towns and districts have arrangements whereby they can obtain the services of an expert when that is necessary. Furthermore, a bachelor of surgery of the London University can take the degree of master of surgery in otorhinolaryngology and a special diploma in those subjects may be obtained, under certain conditions, by a member of the Royal College of Physicians and Surgeons. In other universities (*e. g.*, Edinburgh) similar facilities are offered to graduates who have taken up the study of particular subjects.

If time permitted I could tell you, who live in this comparatively young and enlightened country, some astounding stories of the difficulties we met with in gradually overcoming the conservatism, the vested interests and often the jealousies of those to whom tradition and precedence were as the breath of life.

Otology. As this is the senior member of our triology, we may consider one or two of its problems which often confront us in our daily work. Before doing so, just one or more retrospects: When I graduated, in 1890, my teachers occasionally performed a cortical mastoid operation and left the postaural wound widely open. This was packed daily for six weeks to two months, until the wound had healed. I remember one case alloted to me when "dressing" for my chief, and that patient is now surgeon-admiral of the British fleet. If the complete tympano-antral operation was performed, no meatal flap was cut and the postaural wound was dressed in the way I have already stated. You will realize the tedium of such after-treatment inflicted on both patient and surgeon.

In 1886 the first *successful* operation on otogenic brain abscess was performed in University College Hospital by the late Arthur E. Barker, who was then one of the assistant surgeons of that institution.

Practically nothing was known in those days with regard to labyrinthine tests in health and disease, and consequently the medical or surgical treatment of inflammatory lesions of the internal ear structures scarcely existed.

The symptom-complex which we speak of as Ménière's disease was, of course, well known to physicians, and one of my teachers, Sir William Gowers, maintained that vertigo was of aural origin in 90 per cent of the cases. The late Mr. Mark Hovell, aural surgeon to the London Hospital, was more explicit as to the nature of the ear lesion, and recorded that most of his patients who consulted him for vertigo suffered from postnasal catarrh, and, insofar as this could be relieved or cured, the attacks of giddiness would be minimized in their frequency and severity. Many of us who were his juniors have since then amply proved the correctness of his observation. In the early part of this year Mr. Sidney Scott (*Proceedings of the Royal Society of Medicine*, 1929) has again upheld the same view, and says that the largest class of recurrent vertigo is "associated with inefficiency of the Eustachian-tube mechanism." Let me give you two illustrative examples; both the patients are medical friends of mine and this is what they have written to me:

Dr. M. T. was seen by me in August, 1925, for attacks of vertigo similar to those which he had had for thirty years previously and about the time of puberty. Since then the attacks were more frequent in the summer, but for the last two years there had been no seasonal incidence. The general health had been good and he was never "off work." He says, and this is significant: "I am usually able to avert a bad attack by a gentle massage according to Valsalva's method." My second friend sent me the following more detailed account of his attack:

"In June, 1928, I had an attack of giddiness, during the first day of which I vomited several times. Dr. James Collier kindly visited me twice when I was at my worst, but he found, I believe, no objective phenomena. I was not confined to bed, although I was on a couch most of the day. I was considerably troubled by loss of coördination in my legs; I dreaded passing the stairs to my basement, and was troubled in crossing the pavement between my car and the house I was visiting.

"The attack ended in a dramatic manner. I had been ill for about a month. One afternoon I reached home about 5 o'clock and sat down in an armchair with a daily paper and fell asleep. The extension telephone in my bedroom rang and I jumped up and went to it. As I passed a looking-glass I noticed that my face was very pale. I answered the phone and fell upon the bed. I lay there for a few minutes and when I got up my giddiness and loss of coördination had completely disappeared.

"From then until February 1, 1929, I was well. On February 1 I had

a busy day and got home for an appointment at 5.15 P.M. I saw my patient out at 6 o'clock and I immediately became very giddy and vomited. I went to bed and felt very ill. I was very giddy and vomited frequently. I had intense photophobia; the slightest ray of light made me vomit. I could not bear the light from the gas-fire and a screen was placed around my bed to keep the light from the street lamps, etc., out, although the windows have venetian blinds and curtains.

"On the following day (Saturday) Dr. Gordon Holmes visited me twice. I was vomiting when he arrived at 9 A.M. He gave me a mixture of sodium bromide, chloral and Prussic acid, and the vomiting ceased. He told me that I had well-marked nystagmus. I remember nothing more about that day except that I lay with my head under the bedclothes, because of the light, and I had complete anorexia.

"The whole attack passed off in a few days and a friend kindly put her car and chauffeur at my disposal. I used it for about a month and then took out my own car. Only once since have I had any sign of it and it only lasted half a day.

"My vertigo was, with the exception of the February attack, only slight; everything was on 'the move.' My wife and daughter told me that they knew when I was unusually bad, by my pallor. I am not a bilious subject, am never troubled by constipation and I never vomit. I have never suffered from any ear trouble. I had no pain."—G. W. I., August 29, 1929.

In this interesting clinical account of my friend we note the recurrence of visual and gastric disturbances and the cardiovascular symptoms of pallor and collapse. These were not the causes of the vertigo, but, as Sidney Scott says, they must be regarded as "secondary reflex results of the excessive stimulation of the vestibular centers in the medulla."

On my return from vacation, the second patient came to me, still feeling rather unsteady, but deafness in the right ear was his chief trouble and the ordinary tests showed it to be of middle-ear origin.

I inflated his tubes and the effect was dramatic, for the hearing immediately returned, the dizzy feeling disappeared and he walked out of the room in high spirits and with the greatest assurance. There has been no recurrence of the vertigo.

In both these patients it is clear that this symptom was caused by occlusion of one of the Eustachian tubes. And how serious it may be in air pilots and the personnel of submarines! I have often wondered whether vertigo may not account for some of the deaths from drowning during the holiday seasons, *i. e.*, a sudden attack of giddiness with possibly a cardiovascular disturbance due to water entering one Eustachian tube, rather than to the so-called "muscular cramp."

Before leaving the subject of vertigo, I should like to mention those cases in which Ménière's syndrome is caused by an abnormally *low blood-pressure*, rather than by a high arterial tension with which we are all familiar. My colleague in the Royal Ear Hospital, Mr. Richard Lake, was, I believe, the first to draw attention to this factor. One of my patients was an elderly lady who for months was almost bedridden by frequent and severe attacks of vertigo. Bromides and the other usual remedies failed to give relief, but ergotine preparations, such as "Ernutine," would almost immediately cure an attack, and when this treatment was followed by cardiac tonics the patient resumed the ordinary quiet routine of her daily life. But she always kept "Ernutine" at hand.

Coming to chronic suppurative lesions in the middle-ear cleft, I should be glad to know your experience in the surgical treatment of "attic" suppuration, *i. e.*, are you in favor of ossiculectomy, or do you find that a conservative mastoid operation is the better procedure? My experience would seem to show that the main cause of chronicity lies in the infected antrum or its adjacent mastoid cells, and that a postaural operation is more likely to cure the discharge from the attic and to conserve whatever hearing there may be in the affected ear.

Again, what has been the experience of those of you who have tried immediate closure of the wound after a simple or Schwartze mastoid operation, whether for acute, subacute or possibly chronic suppuration?

Some twelve or thirteen years ago I showed, before our Section of Otology of the Royal Society of Medicine, 5 consecutive cases in which the method had been adopted with success. In 1 of them a perisinus abscess had been present. The technique included the removal of every visible focus of infection, the application to the bone wound of hydrogen peroxide solution, then of methylated spirits and, finally, a free application of bismuth and iodoform suspended in liquid paraffin. After insertion of the skin-wound sutures, pressure is applied to the wound in order to squeeze out as much of the B. I. P. mixture as possible.

The longest time any of these patients was in the hospital was sixteen days, an enormous saving of time compared with the ordinary requirement. I have had no fatal result nor any complication more serious than the recurrence of discharge in a few cases, which necessitated the opening of the lower part of the wound to provide for

drainage until the usual obliteration of the wound by granulation tissue took place.

The cases which do best are those in which the suppuration has been present for five to six weeks and, therefore, we may presume some protective immunization has been secured. In two acute cases the edema over the mastoid process was ½ inch thick, and yet the patient did well and the wound healed by immediate union. The method has been very successfully adopted by Guthrie, of Edinburgh, by McNab, of Johannesburg, and others, but it has not been so generally adopted as one might have expected by those whose asepsis and surgical technique is of the highest order. One is quite aware of all the theoretical objections against immediate suture, but by practical experience these appear to be possibilities rather than probabilities. I was encouraged to adopt the method because of the successful result which followed the B. I. P. treatment of wounds in the World War.

I should now like to record a case which is unique in my experience, viz., "pyemia of aural origin without sinus thrombosis." Körner (of Frankfort-a/M) was the first to describe such instances, and the late Henri Luc (Paris) published two from his own practice. (You will find them in his *Lectures on the Suppurations of the Middle-ear.*)

My own patient was a finely built boy in one of our public schools. He had had an acute otitis of the left ear, quickly followed by discharge. This ceased in a few days, but the temperature instead of falling increased in its daily excursions, and when I saw him, some three weeks later, in consultation with his medical attendants, the following conditions prevailed:

The tympanic membrane was normal and the hearing was very little inferior to that of the sound side. The soft tissues over the mastoid showed no sign of present or past inflammation, and deep pressure on that process elicited no discomfort, nor was there any tenderness or swelling over the course of the jugular vein. The patient felt quite well except when the evening temperature rose to 102° to 104°. He was cheerful to the extent of facetiousness and said he was looking forward to a good dinner. The temperature chart was of the swinging type, such as one would expect in a case of septic thrombosis of the lateral sinus. Urine was normal. No blood examination had been made. On further general examination I found a very tender area over the symphysis pubis, another behind the left trochanter and a very tender spot in the left gastrocnemius muscle.

It seemed, therefore, that we had to deal with a case typical of those described by Körner and Luc, pyemia with distal foci of aural origin.

A few days later, right pneumonic symptoms with pleurisy developed and the boy died. To add to the tragedy, I may mention he was an only son and captain-elect of his school.

The pathology of such conditions is not clear, but the theory most in favor is that the pyemia results from minute septic thrombi in small veins of the mastoid process which pass through the pulmonary capillaries and find lodgement in distant regions. In lateral sinus thrombosis the larger thrombi, as we know, become lodged in the pulmonary vessels.

What should have been our treatment? I advised against mastoid and lateral sinus exploration because I knew that this had been done in other cases without finding any focus of infection, and that in two fatal cases the pathologists found no evidence of mastoid infection or of sinus thrombosis. Furthermore, the literature on the subject clearly showed that if, during the remissions of temperature, the general condition of the patient (as of mine) was good, recovery usually took place. And, as I have said, there was no sign or suggestion of any mastoid or sinus complication.

I still think I was right in not operating, but shall esteem any favorable or adverse criticism which you may care to offer, especially if they are the result of practical experience.

While I write these lines I have a little boy under my care who has recovered from bilateral acute suppurative otitis media for which the left mastoid was opened and found to be infiltrated with pus. His temperature still continued to rise every evening to 102° to 103° for three weeks, when the left external rectus became paralyzed, the temperature rose to 104.8° and was accompanied by temporal headache. In the meantime the discharge from the right ear had ceased. The wound was explored and the apex of the petrous pyramid searched for a possible cause of these symptoms, but without result except for the escape of a considerable quantity of serous fluid. Still the swinging temperature was maintained. But all the time since the commencement of his illness, during the remissions of temperature, the patient read story-books, was interested in all that went on around him and was always ready for his food. The sixth nerve paresis is quickly subsiding, his temperature has been practically normal for the last week and he is running about the ward. Was this a case of aural bacteremia, as first described by Gruening (New York), which has been slowly overcome by natural processes? In view of the persistent septic type of temperature, the supervention of Gradenigo's symptom and the temporal headache, was I right in making the second exploration? It was so hard to stand by and do nothing in face of so many grave

possibilities. Here, again, I invite any criticism born of your experiences, and ask whether you have found autogenous vaccines from blood cultures, subcutaneous injection of normal saline solution or the internal administration of urotropin of any value? Blood cultures failed to detect any organisms in my patient.

One other small point of practical interest before leaving otology. Many years ago I had under my care, at surprisingly brief intervals, 3 patients with sarcoma (or endothelioma) of the nasopharynx, and in each case an early symptom was deafness due to the accumulation of a viscid mucoid secretion in the tympanum on the side corresponding to the primary nasopharyngeal lesion. Paracentesis in such cases naturally failed to give more than temporary benefit. Further experience has led me to believe this symptom to be a very common one and its significance may easily be overlooked if we fail to examine the posterior nasal regions. Sir William Milligan has emphasized the same points.

Rhinology. "Chronic nasal catarrh" is probably the commonest symptom for which patients consult us. Its causes are to be found in the standard textbooks, but I would like to emphasize a few factors upon which the authors do not seem to me to lay sufficient stress:

We all know that the most frequent cause of chronic nasal catarrh in children is adenoids, or adenoids and tonsils, while a relatively small number may be due to an added sinus infection. The treatment of these conditions is obvious. But there is often more difficulty in curing the trouble in adults, when such definite conditions do not exist. I would humbly suggest that one reason for our failure is that the posterior rhinoscopic mirror frequently does not reveal the fibrous and septic remains of old adenoids which digital examination or endorhinoscopy would detect.

Second, many of these intractable catarrhs are caused by secretions from polypoid degeneration of the antral mucous membrane. Hence, my practice, that, if no obvious lesion be visible or palpable in the nasal passages, I puncture and irrigate the antrum, and as often as not the lotion brings away a large nummulus of mucus or mucopus. In mild cases a few irrigations followed by injections of argyrol, 15 per cent, will bring about a cure. If it fails to do so, an operation to provide for free nasoantral drainage will often secure the desired result. It is surprising how often the antral mucous membrane undergoes polypoid degeneration without any sign beyond a chronic nasal catarrh.

I need scarcely dwell on the diagnostic value of lipiodol injections of the antrum, followed by radiography, especially when one antrum is affected by polypoid degeneration of its mucous membrane or when the lumen is invaded by a new growth.

Having spoken of a common nasal condition, may I give you a brief account of a rarer condition, viz., aspergillosis of the maxillary antrum. You will find an account of it in the *Proceedings of the Royal Society of Medicine* (1914–1915, vol. viii, Pt. II), and I think it was the first record of the affection as observed in 5 cases. The symptoms were violent sneezing; expulsion of grayish-white, semi-translucent, viscid lumps of mucus and headache and neuralgia around the cheek and eye, which in 1 patient was so severe as to prevent sleep. The nasal mucosa was pale and edematous, and the swelling was not reduced by 20 per cent cocaine. In 2 patients the inner antral wall bulged into the nasal cavity; no fluid returned on attempted irrigation. In 1 case the ethmoidal cells were involved.

On opening the antra through the canine fossa a blue-gray mass presented itself, and on removal it proved to be a very sticky mass resembling the contents of a muscatel raisin. The Caldwell-Luc operation was performed in each instance and the trouble quickly disappeared after some ten days of irrigation with warm normal saline solution.

The pathology of the condition was established by the late Prof. S. G. Shattock, who stated that the material consisted of a homogeneous matrix containing scattered spheroidal cells which, in some regions, were grouped into narrow lines and consisted of polymorphonuclear cells. A microscopic section resembled an endotheliomatous tumor of the salivary gland. In certain cases the viscid mass was permeated by a well-developed mycelium which differed from that of thrush (*Blastomyces albicans*) in that its extension did not take place by constricted budding, but by simple lateral extension of short processes of uniform diameter.

I would like to show you this unique specimen of osteomyelitis of the calvarium, and some slides sent to me by my friend, Logan Turner, of Edinburgh, which show possible tracks of septic infection of the meninges which may follow operation on the ethmoid labyrinth. It is historical in the sense that it was the first recorded case of its kind and followed an operation for bilateral suppuration of the frontal sinuses performed by me in 1899 (*British Medical Journal*, 1899). Many extensive but superficial operations were performed

in the hope of checking the spreading inflammation, but after nine months of suffering the patient died and the autopsy revealed foci of suppuration in many of the internal organs.

If we had the misfortune to meet with such a complication today there would be no hesitation in exposing the whole frontal bone and commencing on a healthy area well beyond that infected. The whole thickness of the bone would be removed, including the inflamed regions.

I know of only two precautions which may prevent or minimize the chances of such a complication, viz., to provide for free drainage from the operated sinus and in no circumstances to employ a curette for the removal of diseased mucous membrane, which can easily be done with blunt forceps or with wool firmly twisted on a probe.

Throat. The mere mention of this region suggests that threadbare subject, the tonsils. I can image you, Mr. President, rising in authority from your chair and saying, "I forbid." If you do so, no one will be more grateful than I, because only a few hours ago I raised some issues on the subject in Chicago, and, wondering how many enemies I might have made, I got on the railroad next morning, in my haste to reach Philadelphia (which from its very name, and all I have heard of it, deserves the distinction of the City of Brotherly Love). One problem I did not mention in Chicago may perhaps be mentioned here. Assuming that no tonsil can at any time be entirely free of pyogenic and possibly pathogenic organisms, what macroscopic and early clinical signs have we that it has reached a stage which renders it a possible focus of local or systemic infection?

Your colleague, Dr. G. B. Wood, has emphasized the pathological significance of excess of polymorphonuclear cells in the crypts, or making their way thereto through the epithelial cells which line those recesses; but the surgeon needs some early and naked-eye evidence of disease if he is to make a proper selection of cases for surgical treatment.

A mere slight enlargement of the tonsils is not necessarily a call for their enucleation, because it will frequently subside by the establishment of normal nasal respiration, *e. g.*, marked septal deflection or moriform hypertrophies of the posterior ends of the inferior turbinates. Nor is the presence of physiological débris in the tonsillar fossa necessarily a condition requiring surgical treatment. If it were so, "who amongst us shall escape whipping?" In this

matter I would ask, "How far has Dr. French's tonsilloscopy helped you?"

Another point I would like to mention, viz., that which deals with the question of checking hemorrhage during and after tonsil operations. There are many well-known operators in all countries who advocate stopping the bleeding by pressure of gauze swabs or sponges. I ask them, or any surgical confrère, "Why do you adopt a measure for arterial bleeding in a tonsil recess which you would not employ in any other accessible region of the body?"

With a little practice we can find and ligature the chief vessels in a few seconds and leave the home or hospital with an easy mind. How can we do so when we know that the strain of vomiting or restlessness may burst open an unsecured vessel? Let us think for a moment of the resulting anxiety for parents, husbands or wives, to say nothing of the additional suffering of the patient, and, maybe, the safety of his or her life, for which we have made ourselves responsible.

That it is a common complication is proved by the flow of literature on the subject and the frequency with which instruments are being devised to avoid it. Of its possible seriousness we, no less than the public, are aware. Let me read you what that experienced and shrewd observer, the late Mark Hovell, said on the subject eight years ago, on the occasion of the summer meeting of the Section of Laryngology of the Royal Society of Medicine, London:

> "It has often been stated that the hemorrhage which follows tonsillectomy is of but little consequence; but possibly opinions differ as to what is considered a serious extent. Rather more than a year ago I heard from a creditable source that a throat specialist had then had four deaths from hemorrhage following the enucleation of tonsils; but since then I have not been in a position to hear of his more recent contributions to the cemetery. As regards the members of this Section, I will not refer to deaths, but will merely mention that to my knowledge there is more than one of them who, following enucleation of the tonsils, has been confronted with hemorrhage to a degree which caused him grave anxiety."

In my own practice, by ligaturing the descending branch of the posterior palatine above, and often the tonsillar branch of the facial below, I have in 1000 carefully recorded cases reduced my average of postoperative hemorrhage from 5 per cent to less than 1 per cent. One of my students has written that I am in the habit of saying, "You should ligature the vessels in every case, whether it be in a man, woman, child or curate."

If I am too dogmatic on this point, it is because, as I have already said, we cannot have too great a regard for the safety and sanctity of lives entrusted to our care.

Laryngology. As my friend, Sir St. Clair Thomson, has been blazing laryngological trails through the States, it is obvious that I need say nothing concerning malignant and tuberculous diseases of the larynx. Only two slides I would like to show you.

The first is that of a larynx from which an epithelioma of the right vocal cord was removed, and you will note its healthy cicatrix. Thirteen years later I was called to the patient because of great difficulty in breathing. He was practically moribund when I arrived and died a few hours later. The larynx was removed and you will see a growth on the left vocal cord, from which a section was made. Another patient of mine, from whom I removed a primary vocal-cord epithelioma, died fourteen years afterward from recurrence of disease, not in the larynx but in the scar of the skin incision, and it quickly infiltrated the neighboring regions. A third case died of cancer of the prostate seventeen years after the removal of a primary vocal-cord epithelioma.

What do such recurrences imply? The late Professor Shattock once told me that he was of the opinion that, during its growth, a cancer produced a certain degree of immunity, and after operation the patient would live (*qua cancer*) until such protection was exhausted. Then any cancer cells which had lain latent might become active again, either locally or in some more distant area. Had cancer cells lain dormant within the scar of my patient for fourteen years, until a lost immunity enabled them to become active again?

My second slide shows the transverse section of a normal vocal cord, stained by Unna's acid orcein, which shows the distribution of elastic tissue. It also enables one to define the true vocal cord as that portion which is covered by squamous epithelium. You will notice where this passes into the ciliated epithelium leading toward the floor of the ventricle on the upper surface of the cord and to that of the subglottic region below. A squamous epithelioma may develop only within the limits of the squamous epithelium. In the elastic region there are very few mucous glands and hence an adenoma of the true vocal cord is of rare occurrence.

Finally, a rare specimen of intratracheal or, to be more exact, "tracheobronchial papillary granuloma" may be of interest. I

removed it from a very healthy young man who had been "gassed" in the World War. From within a few hours of inhaling the mustard gas he suffered from paroxysms of cough. In the course of a few weeks he complained of difficulty in breathing, and when he visited me the distress was painfully obvious. Laryngoscopic examination revealed a tumor in the lower end of the trachea, which moved upward on expiration and downward on inspiration, a ball-valve type of obstruction and, therefore, suggesting a pedunculated and probably benign formation. I removed it by peroral tracheobronchoscopy the next day. It was attached to the left main bronchus just beyond the carina. In spite of a free application of cocaine and adrenalin solutions the bleeding was very free, but the patient made a quick and uninterrupted recovery. I show you slides of the tumor and a section of it prepared by Prof. S. G. Shattock. Probably the mustard gas caused an ulcer, and its granulations gradually hypertrophied until the inspiratory and expiratory current of air, coupled with the violent coughing spasms, brought about the formation of a pedunculated vascular granulomatous tumor.

And now, Mr. President and Gentlemen, I have only to thank you for your kindly forbearance in listening so long to some of the incidents and impressions gathered on my pilgrimage to the terrace from which I have looked backward.

Of all the factors which have relieved the strife, disillusions and failures on the journey, the two greatest have been (1) the joys of friendship and encouragement given to me, as you have done this evening, by my fellow-travelers, and (2) the steady realization that year by year otology, rhinology and laryngology were establishing their fair names in the science and art of medicine. Perhaps such sentiments would be more gracefully rendered by the well-known lines:

> "Contend my soul, for moments and hours;
> Each is with service pregnant, each reclaimed
> Is like a kingdom conquered, where to reign."

Discussion. Dr. B. Alexander Randall: All cases of chronic suppuration are due to cholesteatoma. If we have a matrix of cholesteatoma we are bound to have an overgrowth of endothelium. Pearl-like masses form and may be compared to those in epitheliomata. They represent a new growth. It is not only necessary to remove the dead bone, but also the matrix from which new epithelial masses form. This should be strongly emphasized.

Dr. James A. Babbitt: I would like to know the essayist's opinion of

the partial procedures recently advocated, such as the removal of the external attic wall alone.

Dr. Matthew Ersner: Dr. Coates has been an advocate of the blood-clot method of closing mastoid wounds. Sometimes a small drain is placed in the antrum. The pathology is checked with the cytology. If the polymorphonuclear count is rising and the total count is falling, either complete closure or the blood-clot method is used. We may even close the mastoid wound with a perisinus abscess present should the polymorphonuclears rise and the total count drop. The osteogenic substances present eventually help in judging the best method of closure. In suppurative otitis media we must politzerize and massage as soon as possible to prevent adhesions.

Hypertrophic tissues may be present in the antrum without suppuration or nasal symptoms. Here lipiodol is a great aid in diagnosis. I am wondering whether salicylic acid in alcohol would be of value in mycelial infections of the antrum.

Why do we not get more osteomyelitis in mastoid surgery—we curette there?

Dr. George M. Coates: We cannot say definitely that ossiculectomy or the various types of mastoid operation are the proper form of treatment until the specific case is analyzed. Suppuration may be mantained by the necrosis of ossicles or by adhesions forming pus pockets. In such cases ossiculectomy is of value, but the cases must be carefully selected. Where the suppuration is not too deep-seated drainage may be obtained by taking away the external wall of the attic or the aditus as well. A more radical operation may be done later on if these measures fail.

Whether a blood-clot dressing is used or a modified blood-clot dressing is a matter of diagnosis. If the middle-ear has cleared up before operation a deep closure will give a healed wound in the shortest possible time without danger to the patient. If trouble arises the wound may be reopened.

In hyperplastic maxillary sinusitis with indefinite symptoms, lipiodol gives a fine outline and differentiates dentigerous cysts from hyperplastic mucous membrane.

Dr. Fielding O. Lewis: Douglas Harmer has treated cases of carcinoma of the larynx by radium alone. It has been a failure in this country. Some success has been attained in extrinsic cancer by the combined treatment.

Dr. Samuel Skillern: If the negative washings from a hyperplastic maxillary sinus are poured into a tumbler (especially in the cold), an albuminous, reddish material settles out on the bottom. The hyperplastic antrum gives a different feel to the puncturing needle. There is also a "hang" to the needle if we move it around inside the antrum.

Dr. George Marshall: Politzer controlled the hemorrhage of aural polyps by snaring and applying the sesquichloride of iron. This absorbs atmospheric moisture rapidly and acts as a superficial cautery. In the case of the septic tonsil, if we go into deeper tissue and ligate, there is a possibility of further infection.

Mr. Herbert Tilley: I am on the fence about the different methods. Ossiculectomy is often followed by drying-up of secretions, but we must consider hearing. The patient should be informed of the future. The

treatment should depend on the condition of the other ear, and each case must be considered on its merits. In the majority of cases I would do a postaural operation.

Where lipiodol shows hyperplastic changes, I treat the simpler cases by injecting argyrol.

Osteomyelitis does occur in the temporal bone, and I have had to turn a flap downward on several occasions; it is, of course, rare. The variation in the blood supply is the main reason for the rarity of temporal osteomyelitis.

I have seen some of Harmer's cases, and the larynx in each case appeared quite normal after treatment. I think this method will revolutionize laryngeal surgery where the cases are got early. In three or four months it is necessary to look at a diagram to tell where the lesion was.

Dr. Marshall mentioned sesquichloride of iron. I will try it in tonsillar hemorrhage, but I always feel safer when I ligate.

NOVEMBER 20

Tic-douloureux, Nasal in Origin: Case Report.

Dr. George Morley Marshall reported the case of a female, aged sixty-two years, giving the history of intermittent pain, starting in the upper lip, near the left naris, going across the left side of the face to the temple, thence to the forehead and back of the eye. Occasionally the greatest pain was near the lip and nose. The attacks had occurred for four years. Pain would continue for about three minutes and then disappear for fifteen minutes to an hour or more. This condition would last for weeks at a time. The pain could be started by placing the finger on the lip at the left naris, or could be stopped temporarily by pressure on the side of the nose at the point where the left nasal bone and the left nasal process of the superior maxilla join. The former probably increased turgidity and pressure, while the latter cut off the arterial blood, reducing turgidity and pressure.

The left turbinates were found crowded, the lower being large, hard and impinging on the floor, even when retracted by cocaine and adrenalin, so that a fine Harrison Allen applicator could not pass beneath. The right nasal passage was more free, but the middle turbinate was hypertrophied and the septum deviated to the right.

A partial left lower turbinectomy, a submucous resection of the posterior portion of the septum and a partial right middle turbinec-

tomy were performed. The pain completely disappeared after the dressings were removed. After complete relief for seven months, a slight recurrence of pain was noted when the patient became unusually fatigued. Rest will probably control this factor.

Discussion. Dr. Karl M. Houser: When I was on Dr. Frazier's service at the University Hospital, ten years ago, I saw quite a number of patients who were sent in for avulsion of the sensory root of the fifth nerve. Most of them had had all teeth removed and, in addition, had had considerable intranasal surgery. Some of them had temporary relief after nasal surgery, but they came to the hospital because of recurrence of their symptoms. Others, no doubt, had secured relief from such procedures and, therefore, did not reach a neurosurgical clinic.

Dr. George M. Coates: Fatigue seems to have been a definite cause of recurrence in this case. What does Dr. Marshall consider the difference between major and minor tic-douloureux?

Dr. George Fetterolf: Was there evidence of maxillary sinus disease in this case?

Dr. Edward H. Campbell: Does Dr. Marshall believe the removal of a turbinate will relieve a vacuum type of headache?

Dr. Marshall: The lowering of tolerance gives a minimal stimulus leverage. This patient improved and gained weight, due to improvement in the nasal condition plus rest. The pressure in the nose no longer exists and a vicious cycle is broken. A major case is one in which the ganglion itself is involved; whereas, a minor one is due to involvement of a branch of the ganglion alone. In this instance there was pressure at the trigger-zone and also pressure in the vicinity of the ganglion due to turgescence. Removal of the turbinate influenced both types of pressure. It would have been proper to wash out this antrum, but there was no indication of maxillary sinus involvement. The factor of pressure was the impressive thing in this patient and its removal was the procedure indicated.

Occurrence of Eosinophiles in the Maxillary Sinus Mucous Membrane of Asthmatics. (Lantern Demonstration.)

Dr. George M. Coates and Dr. Matthew S. Ersner found in 50 cases of chronic maxillary sinusitis, with subsequent radical operation, the pathological alterations consist of hypertrophic and atrophic mucous membrane, polyps or a combination of both hypertrophic and atrophic tissues. The cellular elements in the tissues were found to represent round-cell infiltration—lymphocytes, polymorphonuclear leukocytes and occasional eosinophiles in the non-asthmatic group, while in the asthmatic group there was a predominance of eosinophiles, with some mononuclear leukocytes and lymphocytes.

A study of the pathological histology of the antral mucous membrane in the asthmatic group revealed columnar epithelial cells covering the surface of the tissue. These cells frequently dipped down deeply into the connective tissue and formed small crevices, which, in some cases, branched. Occasionally, the epithelial cells were hydropic and overlaid with thick mucus. A few cases exhibited several layers of cells. An acellular, hyaline zone lies directly beneath the basement membrane and beyond this there are areas of edematous connective tissue which contain many cells, the eosinophilic leukocytes predominating. The remaining cells are mononuclear leukocytes and lymphocytes.

The asthmatic patients, upon whom Caldwell-Luc operations were performed, represented three types, viz., (*a*) the suppurative type, (*b*) hydropic or vasomotor type, (*c*) the nonsuppurative type. From a rhinological standpoint these presented different symptoms, but in the histopathology the eosinophile was the predominant cell. The Streptococcus hemolyticus was the organism isolated in the asthmatic group.

A point in favor of local pathology being a factor in the causation of asthma was emphasized in the case of a patient whose symptoms recurred after three years. This was explained by the regeneration of nasal mucous membrane following radical maxillary operation and the reinfection of the new tissue.

It is customary to expect a disproportionate increase in the polymorphonuclear leukocytes in acute infection, and an increase of lymphocytes where there is a tendency toward chronicity. The eosinophilic index is presumably below normal. Coates and Ersner found eosinophiles present in the asthmatic antral mucous membrane in conjunction with purulent conditions in the membrane. They, therefore, assume that asthma and the presence of the eosinophiles in the mucous membrane must be closely associated.

Discussion. Dr. Phillip S. Stout: The technician at the Jefferson Hospital asthma clinic has reported this condition for some years. We have performed a large number of Caldwell-Luc operations on asthmatics but found that, although they were relieved, the symptoms eventually returned if we waited long enough. There is distinct relation between eosinophilia and asthma, as the nonasthmatic and the asthmatic individual may both show eosinophilia. Sinus disease never produces asthma in an individual not allergic.

Dr. J. Alexander Clark: A number of peculiar things occur in asthmatics, none of which are constant. Hypotension may be mentioned as one of

these phenomena, as well as eosinophilia. It is a question whether eosinophilia has anything to do with asthma, or whether it is just an accident. In a large number of cases which we studied, only one-third of the patients showed eosinophilia in the blood, while the others did not show it at all. In hayfever there is no eosinophilia in the blood. Occasionally 50 to 60 per cent of the leukocytes in the sputum may be eosinophilic. The Germans differentiate between true eosinophiles and pseudoeosinophiles, regarding only as true eosinophiles those with large granules.

Dr. Karl M. Houser: What was the relationship of the eosinophiles in the mucous membrane to the blood eosinophilia?

Dr. George M. Coates: There has been much dispute about the nasal factors in asthma. Is hyperplasia the result of allergy or the cause of the allergic manifestations? That the nose has a specific influence in sensitized individuals may be shown by removing a polyp or some hyperplastic mucous membrane. The word "cure" is always a relative one, but many cases undoubtedly were relieved by minor intranasal procedures.

Tobey, Emerson and Mosher have also found the eosinophiles in their cases. Our asthmatics were relieved when the mucous membrane was removed. What this means is difficult to say, but it is an interesting observation. The occurrence of eosinophilia is so uniform in asthmatic sinus disease that it deserves some thought. Emerson believes that in all cases of vasomotor rhinitis there is disease of the maxillary sinus, and that an atrophic mucous membrane is just as important as a hyperplastic lining.

Dr. Ersner: Recurrence is probably due to regeneration of mucous membrane or to damming-up of secretions. A peculiar slimy fluid is present in allergic individuals. Predisposition to asthma is a debatable subject. The eosinophiles were identified by Dr. Kolmer. We did not check the blood picture in our group of cases nor perform intradermal tests with the isolated organisms.

Lymphoepithelioma of the Tonsil: A Bilateral Case

Dr. Paul O. Snoke reported the case of a white female, aged sixty years, who was perfectly well until December, 1925, when she noticed a sense of constriction and discomfort in her throat. Simultaneously, a mass appeared in the left neck at the angle of the jaw, which enlarged to the size of an egg in one month. There was no history of acute intraoral infection. Physical examination was otherwise negative at the time.

The left tonsil was greatly enlarged, red and hard, and the surrounding structures were indurated. The tonsillar crypts were dilated and clearly visible. The right tonsil appeared normal. In the left neck there was a mass of glands over the carotid bulb. The blood Wassermann was negative.

Following the introduction of radium needles directly into the

tonsil, in January, 1926, the patient remained well until January, 1928, when she developed severe headache and diplopia. There was a mass above and mesial to the inner canthus of the left eye, involving the frontal bone and the frontal and ethmoidal sinuses. This mass displaced the left eye laterally. Several days later dysphagia developed. There was no dysphagia or hoarseness.

Laryngoscopy revealed a mass in the right pharyngeal wall at the pharyngoesophageal junction, which was submucosal. There were no palpable cervical glands. The chest was negative for metastasis by roentgenograms.

Ten days after radiation of the left frontal area and the left and right cervical areas, the frontal mass had disappeared and the dysphagia was greatly relieved. A month later the patient complained of great dryness of the mouth and partial deafness in the left ear. Examination revealed a mass in the left nasopharynx occluding the Eustachian tube and another tumefaction in the left soft palate. Both of these masses resembled the orbital mass. Digital examination of the pharynx and the posterior third of the tongue was confirmatory, except that the right tonsil was found to be stony hard, normal in size and well circumscribed. It did not have the visual appearance of a neoplasm, nor was there any ulceration, but the hardness aroused the examiner's suspicion and a biopsy was taken. Dr. Ewing agreed with the diagnosis of lymphoepithelioma, saying: "It is difficult to distinguish many of these cases from lymphosarcoma. The clinical history helps, and here the absence of nodes in the neck after two years tells against lymphosarcoma." This biopsy was taken from a normally appearing right tonsil, the left tonsil having been destroyed by radium in 1926.

The recurrences failed to respond and the patient died in June, 1928. The significant points in the clinical course of this patient were: The duration of two and a half years; the location in the tonsil; the sensitive radiation response and sensitive metastatic response; the diffuse recurrence (not glandular), and the involvement of the opposite tonsil. The value of palpation of both tonsils in dealing with intraoral neoplasia was stressed. The numerous areas of lymphoidal tissue in the nasopharynx afford easy access to neoplastic cells and metastatic growth, visualization of which means relatively little without palpation.

Discussion. Dr. Bernard P. Widemann: This is an intraoral type of cancer so sensitive to radiation that it has been called lymphoepithelioma to differentiate it. Alveolar-process cancer also responds well to radiation and differs from the usual squamous-cell cancers, which are very resistant to radiation. Cancers of the mouth, and especially of the tonsil, are less accessible and, therefore, are more extensive before they are seen. The pharynx, tongue and peritonsillar tissue are involved by this time and we have to rely on radiation alone. The very early case is rarely observed. The Mayo Clinic classifies these tumors as lymphosarcomas because of the diffusing infiltration which occurs. The peculiar sensitivity of this type of cancer resulted in reclassifying it. Varying classifications are given by pathologists; but the more highly cellular a cancer is, the more sensitive to radiation and the more malignant.

Electrocoagulation causes slough, suppuration and pain, so that seeds plus heavy external radiation to the physical limit of the patient and toleration of the skin have been employed. If there is gland involvement, then the chance of cure is very slight.

Surgeons, until recently, thought they could do a block dissection where gland involvement occurred in oral cancer. If the gland involvement was bilateral, this was hopeless. Block dissection in the unilateral cases has given good results. We now feel that if there is surgical metastasis, the case is inoperable. Many cases on record as cured cancer of the tonsils probably belong to this group. In this case metastasis probably occurred before treatment was instituted.

Dr. Fielding O. Lewis: This patient died of starvation. Was esophageal involvement treated in a similar fashion as the other lesions? One patient treated at the Philadelphia General Hospital had tonsillar involvement but no peritonsillar extension. There was a palpable gland in the neck. He is still living six years after treatment. Many cases of cancer of the tonsil have done well under radiation, even where the tongue, soft palate and pharynx were involved. In one patient the alveolus, part of the tongue and the soft palate were treated first with desiccation and later with radiation, with very splendid results.

Dr. James A. Babbitt: A case of lymphosarcoma of the tonsil at the Lankenau Hospital received external crossfire radiation. With the disappearance here, a swelling appeared in the superior carotid triangle of the neck. This was also radiated. Later a careful dissection was made by Dr. Deaver; but in a few days general metastasis, especially to the mediastinum, occurred and the patient died.

Dr. Snoke: The pathologist is playing a large rôle in determining the degree of treatment. We need standardization of pathological classification. Some of these patients get well. Those who die make their exodus in a two-year interval. In this case we did radiate over the esophageal region. We now regard it as unwise to go in and interfere after we get a hard, fibrous mass following radiation. We always persuade the patient not to have further interference, as this leads to metastasis and a vicious recurrence.

DECEMBER 18

Report of a Case of Sinus Thrombosis Presenting Some Interesting Features

Dr. Benjamin D. Parish found that seven weeks after exposure to scarlet fever and a protective inoculation of antiscarlatinal serum, a boy, aged ten years, developed earache, with a temperature of 104° F. An incision of the bulging left drumhead liberated bloody serum, but his condition was no better on the following day, and operation revealed a hemorrhagic mastoid, the general appearance of the bone being that of an acute osteomyelitis. A pure culture of Streptococcus hemolyticus was obtained from the antrum.

After operation, the temperature dropped to 100° F., but within the next two days rose to 105° and 106° F. Blood cultures were negative. The internal jugular was ligated, and through the original incision the inner table of the mastoid over the sigmoid sinus was removed and the sinus found bathed in pus. The sinus wall was very dark and firm to the touch. The clot was removed from the sinus.

A stormy period followed, with the temperature ranging from 105° to 100° F. Five days after operation he received 250 cc. of his father's blood without improvement. That night the father developed a streptococcic tonsillitis. One week after opening the sigmoid sinus the patient had the first chill and, following the administration of 20 cc. of 1 per cent solution of mercurochrome, the temperature rose to 107.2° F. Eleven days after the first operation the blood first showed a positive culture of Streptococcus hemolyticus. The following day, skin tests being negative, an intravenous dose of antistreptococcus serum was given. Less than 5 cc. of serum, however, produced anaphylactic shock and the boy hovered between life and death for twenty minutes, but revived under large doses of adrenalin and general stimulation.

Mercury succinimide intravenously, on the thirteenth day, was followed by a chill and a rise in temperature to $108\frac{3}{5}$° F. On the fifteenth day, the father having sufficiently recovered from his tonsillitis, another transfusion of 300 cc. was given. Marked improvement followed this. Three more transfusions were given at intervals of two days, and a second dose of mercury succinimide. Improvement was rapid from this time on and the patient was

discharged from the hospital, with the wound healed, one month and twelve days after admission.

Dr. Parish concludes that no chemical agents can be relied upon to render an infected bloodstream sterile, and that the real weapons of attack are repeated blood transfusions, supported by spiritus frumenti and arsenic, and that if it is possible to obtain the blood of a donor just recovering from the same type of infection the surgeon may consider himself especially lucky.

Discussion. Dr. B. Alexander Randall: The influence of the father's blood in this case is of extreme interest. While transfusion is frequently indicated, a suitable donor may not be available. In such instances the intravenous use of saline solution is of value. Elimination by the skin and kidneys lessens the septic condition of the patient. Blood from a donor in the recovering stage is certainly of great aid.

Dr. Curtis C. Eves: With temperatures of 107.4° and 108.8° F., I think Dr. Parish should be congratulated in getting this patient well. The blood of a patient recovered from a sinus thrombosis should be valuable for some time. However, there are many types of streptococci, and the difficulty would consist in securing donors with the same type of streptococcic infection as the patient.

Dr. Robert J. Hunter: Dr. Igleton has advised taking cultures in desperate cases and vaccinating donors. Of course, this takes time; but, as the transfusions go on, the donor is developing his immunity to higher levels.

Dr. George M. Coates: Dr. Igleton vaccinated donors from time to time to various organisms, to maintain their immunity, so that they are available as occasion arises. I did a sinus-thrombosis operation on a mother, and eight years later did the same on the daughter. The father's blood was not of value, but one transfusion of the mother's blood ended the whole matter.

Dr. James A. Babbitt: One case of Dr. Butler's recovered, due to the use of mercurochrome under Dr. Piper's direction.

Dr. Parish (closing): I was interested in bringing out discussion regarding chemical agents of value in bloodstream infections. We used succinimide of mercury because, in one of Dr. Fielding Lewis' cases, recovery was felt to be due to this agent.

Syphilis of the Temporal Bone, With Acute Pneumococcic Meningitis. Report of a Case

Dr. Robert J. Hunter and Dr. William P. Belk presented a case, of a man picked up on the street unconscious and brought to the hospital, with no marks of identification. It was quite evident that he had a purulent meningitis with profuse purulent otitis. On brief examination, it appeared that his ears were the portal of entry. Examination of the spinal fluid showed

3550 cells, 100 per cent polymorphonuclears, with a micrococcus in the smear. This, at once, made the case appear hopeless; but, in view of the recent work of Dr. Kolmer and Dr. Eagleton, we determined to give the man what small chances there were. We did a radical mastoid on the left ear, which appeared to be the worse, and having found no definite leads to the brain, after exenteration, we turned to the right ear, on which we did a simple mastoid, having found there was relatively no involvement, the inflammation being confined chiefly to the middle-ear region. We then trephined over the posterior horn of the left lateral ventricle and inserted a needle into the cisterna magna and washed through-and-through. Another needle was inserted in the lumbar spine and lavage from this point to the cisterna magna was carried out. Normal salt solution was used.

The patient improved wonderfully after the operation. In twelve hours he was conscious and well oriented. We got in touch with his physician and found that he had been under treatment for syphilis. The patient did not take salvarsan well. He had been taking bismuth. The history of his case was not available, but his physician had suspected an intracranial condition and had ordered him to the hospital. He was on his way there when he fell over on the street.

We performed lavage of the cerebrospinal system the second time and injected the formalin solution into the spinal canal. The patient did not improve with the second injection. In forty-eight hours we had a report that the Gram-positive micrococcus, first observed on the day of admission, was the pneumococcus. On the same day the patient died.

Autopsy revealed a frank, purulent meningitis, with thick yellow pus covering the base of the brain. The appearance of the petrous bone was very unusual: There was a bilateral, more or less symmetrical, involvement of the apex of each bone; the dura was gone and both bones were eroded and had a motheaten appearance. It was evident that this was the source of his infection and not from the usual mastoid area.

The bones were taken for sectioning. We used the Nagel method. This takes a year, and with interuptions has taken us two years. The last sections have just come through. The slides are exceptionally fine and well repay us for the time spent.

[Dr. Hunter then exhibited a number of sections of the temporal

bone and brain, demonstrating the anatomy of the internal ear, the chronic lesions in the syphilitic areas and the acute invasion with the pneumococcus.]

Discussion. Dr. B. Alexander Randall: Such work is carried out in very few countries, and it is gratifying to see such work and such technical care in working out these delicate structures. The Mütter Museum is fortunate in having a great collection of such studies.

Dr. Benjamin Parish: We had a case seven months ago which was probably syphilitic, as this was, but we failed to obtain an autopsy. On admission, the ears were running and there was evident meningitis. The Wassermann was 4+. We operated, but the patient died in three days. The symptoms may have been due to cerebral syphilis or to brain abscess independent of syphilis, and due to the ear abscess. I do not know whether we were justified in looking for an abscess. Should we have regarded it as syphilis?

Dr. Stephen Weeder: I reported a case of meningitis. A playmate of the patient developed evident meningitis with 3000 cells in the spinal fluid. The recovery was complete in a week.

Dr. B. Alexander Randall: I always question about the pulse-rate, because in brain abscess few cases fail to show a decided slowing of the pulse. This is the most characteristic feature of brain abscess. The rate is slow even if meningitis is also present. I have seen 30 or 40 such cases.

Dr. Edward B. Gleason: The number of cells is not of great consequence if no bacteria are present. Polymorphonuclear cells indicate an active process, while lymphocytes indicate a more chronic process.

Dr. Hunter (closing): This patient showed no symptoms of brain abscess and no slowing of the pulse. The blood-pressure was 140 systolic and 80 diastolic. A patient with a 4+ Wassermann may also have an additional infection. One patient was referred for a differential diagnosis between lateral sinus thrombosis and cavernous sinus thrombosis. Erosion in the nose and blistering of the mucous membrane indicated syphilis, and the Wassermann proved to be 4+. The entire process subsided under anti-syphilitic treatment. In another case it was thought that the facial palsy present was due to syphilis, but the ear was found to be involved, and, following a mastoid operation, the facial palsy cleared up.

The question which Dr. Gleason brings up is important. The decision only too often rests upon the bacteriological reports. Often several days elapse before the report is obtained and valuable time is lost. In one case, showing 2000 cells, successive taps were done and no organisms found. The patient got well with no other treatment than the spinal tapping.

Atresia of Larynx, a Problem in Treatment

Dr. Louis H. Clerf and Dr. Edmond L. Aucoin presented the case of a man, aged thirty-two years, who was struck across the front of the neck by a stick of wood thrown by a saw, and knocked uncon-

scious. An emergency tracheotomy was necessary the same day. At no time was it possible to decannulate and the laryngeal airway became progressively smaller, ultimately closing.

On admission to the Chevalier Jackson Clinic, fourteen months after the injury, it was found that the tracheotomy cannula had been changed only once since its introduction. No air passed through the normal passages and the airway was completely closed. There was distortion and asymmetry of the larynx. A low tracheotomy was performed; but direct laryngoscopy revealed no laryngeal lumen, and a diagnosis of atresia of the larynx due to cicatricial changes secondary to perichondritis was made. The larynx was probably fractured at the time of injury.

Laryngostomy was performed one month after admission and a new airway established from below upward, keeping close to the right ala of the thyroid, which was apparently the only remaining portion of the laryngeal cartilages. A gauze pack was introduced. The new laryngeal lumen epithelialized very slowly but was complete in two months, and a rubber laryngostomy apparatus was then introduced. The size of the apparatus was slowly increased. Six months after operation the apparatus was removed for a test-period, and within a few days the lumen had contracted to one-quarter its original size. Similar results followed successive test-periods, and it was concluded that the difficulty lay in the lack of support of the soft tissues of the larynx, since only a portion of the right wing of the thyroid cartilage and some small masses of cartilage in the region of the cricoid were found at operation.

It was planned to give lateral fixation first, and then to bridge the gap between this by implants placed anteriorly and posteriorly. Two portions of rib, 8 cm. in length, were removed, and one of these was placed in the soft tissues on each side of the neck alongside of and corresponding to the axis of the trachea and larynx. At the lower ends the grafts were in close proximity to the trachea; at the upper ends the interval between them was somewhat greater. The airway was not entered. Healing took place by first intention.

The lateral splints have now been in place for six months. Definite support is given to the lateral walls, but the anterior and posterior walls continue to encroach upon the laryngeal lumen. It is planned to insert several portions of costal cartilage beneath the mucous membrane, both anteriorly and posteriorly, using the rib transplants as supports. This should provide a more or less rigid

box for the larynx, so that the patient will be able to resume breathing through the normal passages.

Discussion. Dr. James A. Babbitt: Exactly what portions of bone were used? What prospect has the patient of a voice?

Dr. Aucoin: The solid bony portion was used, with the periosteum intact. The patient has a buccal voice. There is no laryngeal voice.

Frontal Sinusitis Complicated by Osteomyelitis and Extradural Abscess

Dr. Karl M. Houser: One week after a slight cold, from which he had apparently recovered, a university student, aged seventeen years, was admitted to the hospital because of severe frontal pain, malaise, nausea and vomiting. There was marked prostration, together with a temperature of 103.4° F. and a leukocyte count of 21,000, of which 84 per cent were polymorphonuclears. Tenderness was elicited over both frontal sinuses and they were dark to transillumination. The antra were negative. The middle turbinates and nasal mucous membrane were slightly swollen and congested. Streams of pus were present at the posterior ends of the middle meati and also in the sphenoethmoidal recesses. Blood cultures were negative.

The boy became steadily worse in spite of general and intranasal medication. The swelling over the right frontal sinus became more marked; inflammation of the right eye, sufficient to cause some fixation of the bulb, developed, together with chemosis. The roentgenologist reported clouding of the left frontal sinus and haziness of the right; clouding of the left antrum; clouding of the right ethmoids and hazy sphenoids. The symptoms were more marked on the right, so that, a week after admission, the anterior third of the right middle turbinate was removed, several ethmoid cells in the region of the nasofrontal duct were opened and the sinus probed. No improvement followed.

On the following day, the leukocytes having risen to 28,000 and the symptoms becoming worse, a small button of bone was removed from the lower inner portion of the anterior wall of each frontal sinus. Both sinuses were found to be filled with thick pus. There was no bony involvement in the right sinus, but bare bone was encountered in the superior portion of the left sinus. A subperiosteal abscess

to the right of the midline and 3 cm. above the supraorbital ridge was evacuated.

Improvement in the external condition of the eye followed this operation and the patient was more comfortable. But fluctuant areas developing in the right frontal and right frontotemporal regions, it was deemed advisable to make three incisions: one about 6.5 cm. above the right supraorbital ridge near the midline; another on a line between this incision and the tip of the ear; and the last, about 2.5 cm. above the right ear. An abundance of pus was obtained and the periosteum found to be elevated. The three wounds were connected by subgaleal tunneling and drained by rubber tubes.

Vomiting, headache, slow respiration and pulse, along with bilateral choking of the optic disks, forced further procedures. Dr. Francis C. Grant removed the anterior wall of both frontal sinuses, finding definite evidence of extensive osteomyelitis. On removing the posterior wall of the right frontal sinus, pus immediately welled into the wound. Upon widening this opening, the dura over the right frontal lobe was found to be covered with granulation tissue and occasional pockets of pus. The diseased bone was removed and then the dura was exposed behind the left frontal sinus, without evidence of disease. The wound was packed wide open and convalescence began at once. Optic-disk choking disappeared in a week and the patient was discharged from the hospital two months after admission. No evidence of abscess has developed during the seven months since discharge and the patient is leading an apparently normal existence.

Discussion. Dr. Francis C. Grant: The question of intradural abscess arose in this case and we decided to explore. It was necessary to incise the abscesses and drain them. After removing the bone, extradural abscesses were exposed. Did he have subdural abscesses? We were not sure, and feared going through the dura in an infected field and infecting an uninfected brain. Therefore, we went no further. The symptoms of intracranial pressure cleared up, and, fortunately, we had to go no further. I am not happy about this patient yet, and will not be until a year has passed. A silent area may still be involved, but the boy is gaining weight and appears well.

I have seen 4 such cases during the past year: 2 cases followed frontal sinusitis, and both died; no choked disk was present, but a large frontal-lobe abscess was found in each instance. Another case, following frontal sinusitis with osteomyelitis, in which there was a frontal abscess, was

drained, packed and recovered. The question of proper treatment of osteomyelitis of the skull is one of radical *versus* conservative treatment. Emissary veins may cause extension.

In Blair's review of these cases he reports 6 of his own, which were treated conservatively, with no curetting and no dissemination of infection, and he feels that this is the proper treatment. Of 37 cases having radical operation, 25 died and 12 are living. Of 9 cases conservatively treated, 6 are living and 3 died. Death is usually due to brain abscess or meningitis.

Chemotherapy, vaccines and intravenous therapy have their champions. We were conservative in this case, draining only as pus appeared. We never made large incisions and never curetted. The boy probably developed an immunity eventually. This probably limited the infection. I feel that conservative treatment is best. Remove the bone and expose the abscess. Do not go through the dura until you have to. Wait ten days, and then you can tell if there is a brain abscess or not. Allow the bone to fenestrate.

Dr. George B. Wood: One of my cases with frontal sinusitis, frontal osteomyelitis and brain abscess, upon which Dr. Grant operated, got well. The reason why so many of these cases die is because the disease is so close to the brain, which is a vital organ. These tend to get well, just as much as osteomyelitis anywhere else in the body, but meanwhile meningitis or brain abscess may appear. The important point in the cases I have seen has been the securing of drainage of the under surface of the skull. Opening down to the dura accomplishes this and prevents extension through the dura. In the future I would open a fairly large area of skull to the dura, and pack away the dura from the diseased skull until the fibrous walling-off process was completed. These cases have a bad habit of flaring up just when you think you have gotten them well. The infection travels extensively through the diploic veins of the skull.

Dr. George M. Coates: The organism in most of these cases is the staphylococcus. What organism was found in this case?

Dr. Grant: Many of Adson's cases are due to x-ray burns, with superimposed infection. The infection is secondary, and his cases do not strictly parallel those about which we are speaking.

Dr. Stephen D. Weeder: Herbert Tilley mentions the production of a trough in the bone which efficiently prevents the spread of infection.

PROCEEDINGS

OF THE

SECTION ON GENERAL MEDICINE

PAPERS READ DURING 1929

JANUARY 28

Dr. Thomas S. Githens (by invitation), "Antigenic Studies on Diphtheria and Tetanus Toxoid."

Dr. William A. Evans, Detroit, Mich. (by invitation), "Indications for and Results of Surgical Treatment of Pulmonary Tuberculosis."

FEBRUARY 25

Dr. C. A. Long (by invitation), "Rumination in Man."

Dr. Simon S. Leopold, "Subarachnoid Hemorrhage."

Dr. Otto Rank, Ph.D., University of Vienna (by invitation), "The Therapeutic Approach to Neurosis from the Psychoanalytic Point of View."

MARCH 25

Dr. Edward Weiss, "Obstructive Emphysema as an Evidence of Bronchial New Growth."

Dr. A. C. Ivy, Chicago, Ill. (by invitation), "Cholecystokinin, the Gall-bladder Hormone."

Dr. Harold W. Jones and Dr. W. H. Knapp (by invitation), "Observations on the Treatment of Pernicious Anemia with Liver Extract."

APRIL 22

Dr. Robert A. Matthews (by invitation), "An Atypical Case of Fatal Verrucose Endocarditis."

Dr. Joseph V. Klauder, Dr. H. Brown and Dr. G. Howe (by invitation), "The Serum Calcium and Potassium Ratio. An Experimental Study in Patients with Skin Diseases."

Dr. Edward L. Bortz (by invitation), "Visceroptosis, its Clinical Significance and Treatment."

Dr. H. R. Glenn (by invitation), "Incipient Lipoid Nephrosis and Phenolphthalein Poisoning."

MAY 27

Dr. Joseph M. Looney (by invitation), "The Preparation and Use of Colloidal Carbon."

Dr. John H. Arnett, "Meningococcic, later Staphylococcic Meningitis, Low Spinal Subarachnoid Block, Laminectomy, Recovery."

Dr. Karl Kornblum and Dr. David A. Cooper (by invitation), "Tuberculous Mediastinitis."

OCTOBER 28

Dr. Joseph C. Doane and Dr. Nathan Blumberg (by invitation), "Experiences in the Inauguration of Teaching in a General Hospital with a Brief Autopsy Report of Service Deaths."

Dr. George C. Griffith (by invitation) and Dr. James E. Talley, "Discussion of Agranulocytosis in Six Patients."

Dr. Charles C. Wolferth and Dr. Alexander Margolis, "Observations on Gallop Rhythm."

NOVEMBER 25

Dr. Edward Weiss, "The Necessity for the Adoption of a Standardized Nomenclature in Disorders of the Kidney with Symptoms of Bright's Disease."

Dr. Charles H. Frazier, "Exhibition of a Patient with Raynaud's Disease, with Relief Following Excision of the First and Second Thoracic Sympathetic Ganglia."

Dr. Eli Moschowitz (by invitation), "The Nature of Graves' Syndrome."

DECEMBER 23

Max Trumper, Ph.D. (by invitation), "The Respiratory Significance of Blood Counts."

Dr. Isaac Starr, Jr., "Studies on the Circulation in the Feet in Diabetes Mellitus and Other Conditions Frequently Complicated by Gangrene."

Dr. Joel J. Pressman (by invitation), "The Absorption of Glucose from the Rectum."

PROCEEDINGS

OF THE

SECTION ON PUBLIC HEALTH AND INDUSTRIAL MEDICINE

PAPERS READ DURING 1929

JANUARY 18

Dr. Peter K. Olitsky, New York City (by invitation), "Certain Anaërobes of the Nasopharynx."

Surgeon-General Hugh S. Cumming, United States Public Health Service (by invitation), "Epidemiology of Recent and Present Epidemics of Influenza."

NOVEMBER 22

Major Arthur P. Hitchens, M.C., U. S. Army (by invitation), "Public Health in the Philippine Islands with Special Reference to the Management of Leprosy, Intestinal Infections, Tuberculosis and Other Diseases."

PROCEEDINGS

OF THE

SECTION ON MEDICAL HISTORY

PAPERS READ DURING 1929

JANUARY 22

Dr. Charles W. Burr, "Dr. Robert Whytt and Internal Hydrocephalus."

Dr. Victor Robinson, New York City (by invitation), "An Essay on Johannes Evangelista Purkinje."

Dr. Edward A. Schumann, "The Early British Contributions to Puerperal Fever." (Being the Centenary of Charles White.)

FEBRUARY 19

Dr. Burton Chance, "Hippocrates and the Aphorisms."

Dr. Harry Friedenwald, Baltimore (by invitation), "An Old Medical Manuscript and an Old Medical Diploma."

Dr. John Rathbone Oliver, Baltimore (by invitation), "Greek Medicine and its Development in the Roman Empire."

MARCH 19

Dr. Leopold Vaccaro (by invitation), "The School of Salernum."

Dr. George David Stewart, New York City (by invitation), "Valentine Mott, M.D."

Dr. David Riesman, "The Teaching of Medicine in the Middle Ages."

APRIL 16

Dr. Edward B. Krumbhaar, "The Early Days of the Oldest Medical Monthly, *The American Journal of the Medical Sciences.*"

Dr. Harlow Brooks, New York City (by invitation), "The Making of a Military Division from the Standpoint of a Medical Officer."

Dr. John Rathbone Oliver, Baltimore (by invitation), "The Puzzles and Mysteries of the Hippocratean Corpus."

OCTOBER 21

Dr. Hobart A. Hare, "Stephen Girard and the Great Epidemic of Yellow Fever in 1793."

Prof. Karl Sudhoff, University of Leipzig (by invitation), "The So-called Import of Syphilis by the Crew of Columbus in 1493 and the Historical Facts."

NOVEMBER 11

Dr. Robert L. Pitfield, "John Keats, the Reactions of a Genius to Tuberculosis and Other Adversities."

Mr. Francis Henry Taylor (by invitation), "The Dance of Death."

Dr. William G. Leaman, Jr. (by invitation), "Cardiology from Harvey to Mackenzie."

DECEMBER 9

Dr. James J. Walsh, New York City (by invitation), "The Pleasant Pathway to Medical Wisdom Through Medical History."

The Harvey Film, produced under the direction of Sir Thomas Lewis and Prof. H. H. Dale, of London, depicts the methods which Harvey used to prove the circulation of the blood, and was shown through the courtesy of the Agnew Surgical Society of the School of Medicine, University of Pennsylvania, Charles H. Frazier, M.D., Patron.

THE ALLEGED IMPORTATION OF SYPHILIS BY THE CREW OF COLUMBUS' SHIP, IN 1493, AND THE HISTORICAL FACTS: A CORRECTION*

By KARL SUDHOFF

PROFESSOR OF THE HISTORY OF MEDICINE IN THE MEDICAL HISTORY INSTITUTE, UNIVERSITY OF LEIPZIG, GERMANY

Especially through the brilliant *plaidoyer* of Ivan Bloch (1901), the error about the transportation of lues from Central America to the Old World, which periodically in the past has found believers, has now again attained almost general acceptance. It is time that it should be again interred, and this time in Spain. A "new" epidemiologic doctrine, for which this theory seems to build such a welcome historical confirmation, has again given it the upper hand, namely, the doctrine of the initial frightfulness of the outbreak of a new disease in an infected virgin territory. In support of this, the alleged terrible initial syphilis epidemic at the end of the Fifteenth Century throughout the entire Old World offered a wonderful paradigm. Under conscientious scrutiny, however, this whole epidemic vanishes like fog before the sun. Lues was found everywhere, because people had begun to look for it and learned how to recognize it. It was already ubiquitous at that time, only up to then it had not been possible to distinguish it from other human plagues. But that will lead us too far afield. Let us look closer at the alleged importation:

On March 4, 1493, Columbus had dropped the anchor of one of his ships in Lisbon on the Tago. On March 9 he had audience there with the king of Portugal, and left on March 13, finally to land with his one ship on March 15 at Palos. On the same day the other ship also arrived at Palos that had been driven toward the north of Spain. Columbus went next to Seville and was ordered from there to Barcelona, where he arrived in the middle of April with some "Indians."

On his journey he had touched at some Bahama Islands, Cuba

* Read, October 21, 1929.

and Haiti. There, then, according to the American fiction, would be found the original home of European syphilis. He at any rate had not become a syphilitic. It is not known how matters stood with the condition of health of his little ships' crews. He himself writes at the end of November, 1492, from Cuba, that no one of his people was sick. The recently rediscovered logbook of Columbus' first voyage will, perhaps, contain interesting details on this point. At any rate, no news has reached us of any acute horrible initial epidemic of lues in Spain in the year 1493–1494. We do have, however, very differently sounding, trustworthy accounts.

The physician, Hieronymus Munzer (died, 1508; working in Nürnberg since 1478) left Feldkirch in the summer of 1494, as the plague raged upward from the South and his entire rich clientele deserted the town. He made a great scientific journey through the south of France and its neighboring districts by way of Lyons, Avignon, Arles, Montpellier, Narbonne, Perpignan, and arrived at the borders of Aragon on September 19, by way of Gavona. He reached Barcelona on September 21, where he stayed until September 26. Then, by way of Montserrat, Tortosa and Villareal, he betook himself to Valencia, where he remained from October 4 to October 9, and then traveled by way of Alicante and Guardiz to Grenada. Here he stayed from October 22 to October 27, and then traveled by way of Malaga to Seville (seven days' rest), and continued to Lisbon, where he arrived November 26, 1494. After six days' sojourn, he turned north and visited Coimbra and San Jago da Compostela, and then turned to the interior of Spain, to Benavente and Zamora. On January 2, 1495, he passed through Toledo, and finally to Madrid, where he rested from January 17 to January 25. Through Guadalajara his way passed through Zaragoza, on the Ebro, where he made his last long stay in Spain. Then he traveled to France, where he visited Toulouse, Orleans and Paris. He passed through the Netherlands (Bruges, Malines, etc.) and directed himself to Worms, where he arrived on April 9, and finally at Nürnberg on April 15, 1495.

Thus Munzer, from September, 1494, to February, 1495, had so thoroughly studied the interior of Spain with a medical eye that it would have been impossible for any noteworthy initial epidemic of syphilis to have escaped him. Especially is this so, as he had described all the epidemiologic relations that contained any medical interest most conscientiously in his penetrating letters of travel,

written in diary forms, which are now contained in the Munich Cod. Lat. 43i.

He found southwestern Europe practically free from epidemics almost everywhere, except that he noted in Montpellier that in the previous month of the year a plague had raged and spread to Tortosa. The entire remainder of Aragon and Andalusia, Portugal and Navarre he found practically free from plague. I would not dream of deducing therefrom that there was no syphilis in Spain at that time. Absolutely no! But, on the other hand, there is no indication of a striking initial epidemic in Spain in this year of the alleged introduction of the spirochete by Columbus, at least according to the records of the physician Munzer, who made this important reconnoitering journey through Spain at this critical time. Could Munzer have got the silly idea that the doughty Spanish physicians, who one hundred and fifty years earlier had observed and written about the Black Death, had overlooked this initial syphilis epidemic of 1493 to 1495?

We, fortunately, have, from a contemporary Spanish source, still another piece of information which confirms the results of Munzer's travel letters in a most complete manner.

A Sicilian from Messina, Nicolo Scillacio by name, had brought his medical studies in Pavia to a conclusion in 1494, with the acquisition of the doctorate, and in the spring of 1495 made a students' journey to Spain, going by ship to Barcelona. The young physician made the personal acquaintance of lues in that harbor and was informed by the Catalanian physicians of the nature of this disease and its arrival there, which had been hitherto unknown to him. Neither had he heard it spoken of in medical circles in Pavia. He writes, on June 18, 1495, a letter to a Pavian colleague, which he followed in March, 1496, with other observations. The knowledge which his Spanish colleague had imparted to him, fortified by his own experience (the first professional medical letter on syphilis!), already contains a noteworthy collection of important facts. Scillacio has learned that the disease especially attacks adults, women as well as men, that it is transmitted by contact, takes its origin in the genitalia and from there is spread to the whole body after an initial fever and general symptoms, among others a pustulous exanthem of the skin. The duration of the disease generally does not exceed a year. The Barcelona physicians, thus, could look back

on an experience of several years with a disease that had come to them from France. Scillacio entitled his letter: "De morbo qui nuper a Gallia defluxit in alias nationes," and on the title of the collected works he adds the word "*new:*" "De *novo* morbo qui nuper a Gallia defluxit." And syphilis was something new, at any rate for the Spanish ports; a new disease picture and a new experience.

Charles VIII's army—that was to spread the infection—contained soldiers from all lands and surely Spaniards among them. In every town they found complacent women. And the way in which war spreads and intensifies sexual diseases has become only too familiar to us since the last terrible catastrophe of the World War. Also, in the siege of Naples (1494–1495), which really was no siege at all, sexual diseases in both armies and civil personnel constituted a daily experience. In witness whereof we have the letters to Venice from Sanuto, which this sailor of wide experience sent home every two or three days. In these there was no word through all the weeks and months of anything extraordinary, which he certainly would willingly have described. In his case, as in any contemporary source in which confidence can be placed, I have come to the same conclusion, namely, that there is no trace at all of the alleged terrible initial epidemic in Italy in the years 1495 to 1496. In the light of the existing evidence, I have already been forced, in 1912, to consider such stories as fairy tales.

And now for the final statement of the propagation of lues during the return of the army of Charles VIII through Switzerland, Germany, etc. In July, 1495, he made his return march through Tuscany, and lay with all his troops until October 10, 1495, before Novara, which was completely surrounded. During October the city surrendered, the defenders being allowed free departure, and thereafter began the dispersal of the army down to its almost entirely French nucleus. But while Charles still remained in Italy, the great ones of the Empire had already busied themselves at Worms with the question as to whether the scourge of syphilis was due to the blasphemy of the people. Thus on the Rhine they already had full knowledge of the bösen Blattern, the malum francicum, the Gallic disease. Thus, long before the syphilis-bearing soldiers from Naples had returned to Germany, the people in western Germany had known for months, if not longer, of this severe disease.

A plague called by the people "bösen Blattern," which God had sent as a punishment, was announced in the Reichstag* on August 8, 1495, and in the fall of 1495 was spread abroad through the entire empire by heralds by beat of drum.

And here I must close this address with the statement that the American origin of syphilis no longer constitutes a really serious historical problem.

[The translator assumes responsibility for any incorrect statements in the above abstract, as in some cases the meaning was obscured by the difficult handwriting. E. K.]

* Edict of the Reichstag at Worms, August 7, 1495.

ANNUAL REPORT OF THE LIBRARY COMMITTEE FOR 1929

Mr. President: In accordance with the ordinances and By-Laws of the College, I herewith submit the following report of the Library Committee for the year 1929:

Total number of volumes in the Library, including the bound volumes and 25,009 unbound "Reports" and "Transactions"	162,834
Number of unbound "Theses" and "Dissertations"	22,969
Number of unbound Pamphlets	184,034
Manuscripts	437

Included in the above are 4455 volumes known as "Reserves," consisting of second copies of some of the more important periodical publications; also 2922 volumes more or less incomplete.

The duplicates, which number 6360 at this date, are not included in the above total.

The following table shows the number of volumes in the various divisions of the Library:

	Bound.	Incomplete and unbound.	Total.
General Library	116,884	2,875	119,759
Lewis Library	13,845	44	13,889
On permanent deposit:			
S. D. Gross Library	3,767	3	3,770
Library of the Obstetrical Society of Philadelphia	217	0	217
Mütter Museum*	190	0	190
			137,825

Received during the year from all sources, 5007 volumes, 15,506 pamphlets and 11,891 numbers of various periodicals.

* The books of the Mütter Museum are not permitted to be removed from the College building.

Divided as follows:

	Volumes.	Pamphlets.	Journals.
General Library	3,208	15,459	11,106
Lewis Library	16		
S. D. Gross Library	15		
By purchase, General Account	836		
In exchange	932	47	785
	5,007	15,506	11,891

Accessions (including 70 volumes of "Reserves"), 3453.

	Volumes.
General Library	3,422
Lewis Library	16
S. D. Gross Library	15
	3,453

Total increase in the number of volumes for the year, 3453.

Photographs received in response to requests sent out during the past year and voluntary gifts, 22. Fellows of the College, 3; other than Fellows, 19.

Total number of portraits listed to date, 21,599.

The individual "Donors" for the year ending November 1, 1929, number 392; this represents 706 distinct presentations. Each gift is duly acknowledged.

The following list shows individual gifts of twenty volumes and over; also the number of volumes presented by the various publishing houses:

	Volumes.
Dr. Henry M. Fisher	139
Mr. Henry Reed Hatfield	196
Dr. William W. Keen	21
Presbyterian Hospital	212
Dr. Joseph M. Reeves	135
Dr. S. Lewis Ziegler	913

From the publishing houses of:

	Volumes.
P. Blakiston's Son & Co.	15
F. A. Davis Company	10
Lea & Febiger	30
J. B. Lippincott Company	18
W. B. Saunders Company	43

The Library is indebted for large gifts of pamphlets and unbound periodicals to the following donors:

Dr. H. B. Allyn
Dr. A. P. C. Ashhurst
Dr. Charles W. Burr
Dr. Williams B. Cadwalader
Dr. Burton Chance
Dr. S. Solis-Cohen
Dr. Francis X. Dercum
Dr. W. A. N. Dorland
Dr. George M. Dorrance
Dr. Augustus A. Eshner
Dr. Thomas H. Fenton
Dr. Henry M. Fisher
Dr. L. F. Flick
Dr. J. C. Gittings
Dr. R. M. Goepp
Dr. J. P. C. Griffith
Dr. S. McC. Hamill
Dr. Hobart A. Hare
Dr. Barton Cook Hirst
Dr. R. J. Hunter
Dr. J. H. Jopson
Dr. William W. Keen
Dr. Joseph Leidy
Dr. B. B. V. Lyon
Medical Library Association
Dr. Charles K. Mills
Dr. B. Newbauer
Dr. C. A. O'Reilly
Presbyterian Hospital
Dr. J. M. Reeves
Mrs. Joseph Sailer
Mrs. C. E. de M. Sajous
Dr. G. E. de Schweinitz
U. S. Public Health Service
Dr. J. C. Wilson
Dr. William Zentmayer

742 new publications were added to the Library during the past year, viz.: United States, 311; Great Britain and Colonies, 152; France, 78; Germany, 176; Italy, 4; all other countries, 15 Of these new publications, 13 were written or edited by Fellows of the College.

9 volumes were presented by the following authors or editors:

Mr. P. A. Buxton
Mr. I. Fisher
Miss Mary Moon
Sir W. Osler
Dr. A. Owre
Dr. W. A. Pusey
Dr. J. N. Rodriguez
Sir H. D. Rolleston
Dr. H. W. Wade

6 volumes were sent by the publishers at the request of the following authors or editors:

Dr. W. A. N. Dorland
Dr. C. B. Farr
Dr. J. A. Kolmer
Dr. R. Pemberton
Dr. S. P. Reimann
Dr. J. F. Schamberg

Summary of the "Funds:"

	Volumes purchased.	Cost.
Henrietta Rush Fales Baker Fund	35	$147.44
Luther S. Bent Fund	11	31.93
William T. Carter Fund	23	90.50
Gerardus Clarkson Fund	13	28.62
Francis X. Dercum Fund	32	177.04
Louis A. Duhring Fund	28	69.35
Augustus A. Eshner Fund	18	144.71
John D. Griscom Fund	56	145.61
Richard H. Harte Fund	69	427.63
Charles T. Hunter Fund	1	1.35
William F. Jenks Fund	64	238.75
Oliver A. Judson Fund	7	17.22
William V. and John M. Keating Fund	6	8.08
William W. Keen Fund	48	213.35
Library Endowment Fund	126	592.54
Horace Magee Memorial Fund	109	607.42
J. Ewing Mears Fund	44	248.11
Charles K. Mills Fund	3	6.50
Weir Mitchell Fund	47	200.48
E. E. Montgomery Fund	19	66.55
John H. Musser Fund	3	16.70
Elizabeth K. Newcomet Fund	5	25.90
William F. Norris Fund	40	179.08
Charles A. Oliver Fund	13	39.56
Philadelphia Medical Society Fund	2	8.28
Lewis Rodman Fund	28	183.50
Douglas Stockton Warren Fund	24	51.07
John F. Weightman Fund	5	19.71
J. William White Fund	39	240.04
Caspar Wistar Fund	41	211.99
	959	$4,439.01
From the General Account—by purchase	777	$6,628.29

Special accounts:

	Volumes purchased.	Cost.
Fund for completing files of journals	64	$238.28
Fund for rare and valuable books	46	1,505.06
S. D. Gross Library Account	15	191.49

	Expended.
Catalogue Endowment Fund—on account of salaries	$46.50
Louis A. Duhring Fund—for general purposes of the Library	12,000.00
Morris Longstreth Fund—on account of salaries	1,107.00
George B. Wood Fund—Library supplies, stationery, etc.	302.86

Number of volumes bound, 1753; this includes the binding of 9202 theses in 475 volumes.

	Visitors.	Fellows.	Total.
Use of Library	8,325	1,774	10,099

The Library has been kept open two evenings each week and on the five minor legal holidays for the same period of time as during the previous year:

Evenings.	Visitors.	Fellows.	Total.
79	1,310	204	1,514

Legal holidays.	Visitors.	Fellows.	Total.
5	86	18	104

These figures are included in the total given for the year.

	1929.	1928.	Increase.
Number of volumes consulted in the Library	52,507	23,377	29,170

The number of books "consulted in the Library" includes only those supplied on demand. Readers have access to the bound volumes of periodicals and works of reference kept on the shelves in the Reading Room, and the Fellows of the College have access to the Book Stacks. There are, therefore, many volumes consulted of which no accurate record can be kept.

	1929.	1928.	Decrease.
Number of volumes taken out .	4,368	4,755	387

Use of Study Rooms: Average number of rooms in use throughout the year, 5. Daily average of the number of volumes in use in these rooms, 102.

	Works.	Volumes.	Cards written.	Printed cards revised.
Cataloguing . . .	1,187	1,240	5,553	4,239

All books added to the shelves during the past year and 289 of the more important pamphlets have been catalogued and shelf-listed; and all bound volumes, including periodicals, transactions and reports, have been accessioned.

Revision of the Catalogue: 7300 cards have been revised, rewritten and filed.

2536 unbound pamphlets and reprints have been subject-headed and arranged alphabetically by subject and by author under the subject.

We have listed November 1, 1929, 1317 current periodical publications, including "Transactions" and "Reports," obtained through the following sources:

	American.	Foreign.
Endowment Funds	60	140
By purchase from General Account	149	357
In exchange	78	160
Editors	70	49
Publishers	90	26
Through the courtesy of the Editor of the late *Therapeutic Gazette*, which has ceased publication	9	6
	456	738
Reports not included in the above	95	28
	551	766

The actual number of periodicals received during the year, including new subscriptions (6 American, 12 foreign), total 1194.

The following is a list of the foreign schools of medicine with which we exchange publications at the present time:

University of	Amsterdam	University of	Königsberg
"	Basel	"	Lausanne
"	Berlin	"	Leiden
"	Bern	"	Leipzig
"	Bonn	"	Liège
"	Breslau	"	Lund
"	Bruxelles	"	Marburg
"	Erlangen	"	Paris
"	Geneva	"	Rostock
"	Giessen	"	Strassburg
"	Göttingen	"	Upsala
"	Halle	"	Utrecht
"	Heidelberg	"	Würzburg
"	Kiel		

During the past year we have heard from Amsterdam, Basel, Berlin, Bern, Bonn, Breslau, Bruxelles, Erlangen, Geneva, Giessen, Göttingen, Halle, Heidelberg, Kiel, Königsberg, Lusanne, Leipzig, Lund, Paris, Rostock, Upsala, Utrecht and Würzburg.

1179 dissertations and 921 theses have been added to our collection.

We have received in cash from the sale of duplicates for the current year ending November 1, 1929: $163.54.

We have distributed books and journals on exchange account to the following:

Barlow Medical Library, Los Angeles, California
Boston Medical Library
College of Physicians and Surgeons, New York
Columbia University, New York
Hennepin County Medical Society, Minneapolis, Minnesota
Medical and Chirurgical Faculty, Baltimore
Medical Society, County of Kings, Brooklyn, New York
New York Academy of Medicine
Orleans Parish Medical Society, New Orleans, Louisiana
Presbyterian Hospital, Philadelphia
University of California Medical School, San Francisco
Washington University School of Medicine, St. Louis, Missouri

We have received exchanges from:

Barlow Medical Library, Los Angeles, California
Boston Medical Library
Cincinnati General Hospital Library
College of Physicians and Surgeons, New York
Iowa State Medical Library
Jackson County Medical Society, Kansas City, Mo.
Medical Society of County of Kings, Brooklyn, New York
Milwaukee Medical Library
New York Academy of Medicine
Presbyterian Hospital, Philadelphia
University of California Medical School, San Francisco
Washington University School of Medicine, St. Louis, Mo.

Several of the exchanges on the above list were made through the Medical Library Association.

With the aid from exchanges and purchases made with the funds appropriated by the Library Committee, we have been able to complete the files of the following journals:

Archiv für Thierheilkunde
Archivio Italiano di Chirurgia
Jahresbericht über die Fortschritte auf dem Gebeite der Chirurgie
Mitteilungen zur Geschichte der Medizin der Naturwissenschaften
Il Tommasi
Zeitschrift für angewandte Anatomie und Konstitutionslehre

Amount of fines collected for the current year ending November 1, 1929, $64.60.

List of rare medical books and works of special interest received during the year: (These rare books have been acquired without in any way interfering with the purchase of current medical publications.)

Incunabula

[Total number of incunabula at this date, 387 Titles, 369 Volumes.]

Andreae, Antonius Ord. Minor. Scriptum aureum super metaphysicam Aristotelis. Venetiis, Antonius de Strata, Cremonensis, 1482.
[*Hain No. *983.*] [*Gesamtkatalag der Wiegendrucke No. 1674.*]
Fund for Rare Books.

Augustis, Quiricus de [Lumen apothecariorum***] Venetiis, Johannes et Gregorius de Gregoriis de Forlivio, 1495.
[*Hain No. 2129.*] [*Manuscript notes.*] [*Bound in ancient musical manuscript on vellum.*]
Fund for Rare Books.

Granollachis Barcionensis, Bernardus [Conjunctiones et oppositiones lunæ cuius libet mensis.]*** *In volgare per gli anni 1485–1550.* [Venetiis, 1489.]
[*Apparently only one other copy in existence. No other copy in America.*]
Presented by Charles W. Burr, M.D., and Edward B. Krumbhaar, M.D.

Hippocrates. [460–370 B.C.] [Libellus de esse aegrorum, Alexandro de Appellatis interprete.] Patavii. [Matthaeus Cerdonis de Windischgretz], 1483. [*Reichling II No. 557.*]
[*Pages from contemporary German used for side-covers.*] [*Initial and capital letters rubricated.*]
Fund for Rare Books.

Meffret. Sermones de tempore et de sanctis. Norimbergae, Antonius Koburger s. Koberger, Norimbergensis, 1487. [*V. I and III in I.*]
[*Manuscript notes.*] [*Illuminated initials.*] [*Hain No. 11004.*]
Fund for Rare Books.

Works of Special Interest

Antoine, De besondere heel-en genees-knost der oog-siekten. In't Frans beschreven.*** En vertaald door. Johan Palfyn.*** Leyden, Vermey, 1714.
Fund for Rare Books.

Audran, Girard. Les proportions du corps human, mesurées sur les plus belles figures de l'antiquité. Paris, Chez Girard Audran, 1683.
Fund for Rare Books.

Barbette, Paulus. Pest-beschryving. Den derden Druck, net historische aenmerckingen vermeedert. Amsterdam, Lescaille, 1664.
Fund for Rare Books.

Bauhinus, Caspar. De lapidis bezaar (sic) orient. et occident. cervini item et Germanici ortv, natvra, differentijs veroque vsu ex veterum et recentiorum placitis liber hactenus non editus. Basileae, apud Conr. Waldkirch, 1613.
Fund for Rare Books.

Bauhinus, Caspar. Theatrum anatomicum; novis figuris aeneis illustratum et in lucem emissum opera et sumptibus Theodori de Bry. Francofurti, Beckeri, 1605.
Fund for Rare Books.

Cardanus, Hieronymus. In aphorismos Hippocratis commentaria luculentissima cum Graeco textu.*** Patavii, apud Paulum Frambottum bibliopolam, 1653.
Fund for Rare Books.

Clusius, Carolus. Curae posteriores, sev plurimarum non antè cognitarum, aut descriptarum, stirpium, peregrinorumque aliquot animalium novae descriptiones.*** *Antverpiae, ex off. Plantiniana Raphelengii, 1611.*
Fund for Rare Books.

De lapidibus. [Strasbourg, Renatus Beck, 1517.] [*Extr.-Hortus sanitatis, 1517.*]
Fund for Rare Books.

Donzellinus, Hieronimus. Discorso nobilissimo e dottissimo preservativo et cvrativo della peste. Venetia, Gobi da Salò, 1577.
A rare work on the plague.
Fund for Rare Books.

Fracastorius, Hieronymus. Della sifilide a Pietro Bemo libri tre nuovamente volgarizzati da Antonio Tirabosco. Verona, Appresso Dionici Ramanzini, 1739.
Fund for Rare Books.

Galen, Claudius. l'Anatomie des os dv corps hvmain. Nouuellement traduicte de Latin en francoys, par Jehan Canappe. Lyon, Dolet, 1541.
*Of extreme rarity like all the books printed by Dolet, especially those in French.****
Fund for Rare Books.

Hollerius Stempanus, Jacobus. De morbis internis libri II. Lvgdvni, Landry, 1587.

Fund for Rare Books.

Hollerius Stempanus, Jacobus. In aphorismos Hippocratis commentarij septem. Recens per Ioan. Liebavtivm.*** Parisiis, du Puys, 1583.

Fund for Rare Books.

Howship, John. Morbid anatomy. London, 1805.

The following manuscript note is on the fly leaf: "These drawings of morbid anatomy were all taken from diseases in my collection, in 1804, by Mr. J. Howship, then a house pupil of mine."

Presented by H. K. Pancoast, M.D.

Israels, Abrahamus Hartog en Daniëls, E. C. De verdiensten der hollandsche geleerden ten opzichte van Harvey's leer van den bloedsomloop. Utrecht, Leeflang, 1883.

Fund for Rare Books.

Massaria, Alexander. De peste libri duo. Venetiis, apud Altobellum Salicatium, 1579.

[*Printer's device on title-page.*]

Fund for Rare Books.

May, Philip. Chiromantia et physiognomia medica.*** Dresden, Mieth, 1697.

Fund for Rare Books.

Opera della medicina de cavalli composta da diversi antichi scrittori, et a commvne vtilita, di greco in bvona lingva volgare ridotta. Venetia, Michele Tramezino, 1548.

Fund for Rare Books.

Préceptes de sante, ou introduction au dictionnaire de santé.*** [Par Jourdain.] Paris, Chez Vincent, 1772.

Presented by A. P. C. Ashhurst, M.D.

Ruini, Carlo. Anatomi del cavallo, infermita, et svoi rimedii.*** Venetia, Appresso Fiorauante Prati. 1618.

[*Carlo Ruini's treatise on the anatomy and diseases of the horse and their treatment, sometimes attributed to Leonardo da Vinci, is usually regarded as the foundation of modern veterinary medicine.*] (*Garrison.*)

Fund for Rare Books.

Spiess, Chrétien Henri. Biographies de suicides. Traduites par J. H. Pott. 2 v. Lausanne, Pott, 1798.

Fund for Rare Books.

Sylvius, Jacobus. Commentarius in Claudij Galen libros de differentis febrium. Parisiis, apud Aegidium Gorbinum, sub insigne Spei, prope Collegium Cameracense, 1561.

Fund for Rare Books.

Tulp, Nicolaes. Observationes medicae. 6 ed. Lugduni Batav. apud Georgium Wishoff, 1738.

Presented by Astley P. C. Ashhurst, M.D.

Viotti a Clivolo, Barptolomaeo. De balneorum naturalium viribus libri quatuor, quorum argumentum proxime sequentes pagellae indicabunt. Lvgdvni, apud Mathiam Bonhomme, 1552.

Fund for Rare Books.

[Watkins, Richard.] Newes from the dead; or a true and exact narration of the miraculous deliverance of Anne Greene, who being executed at Oxford, December 14, 1651, afterwards revived.*** Oxford, Lichfield, 1651.

Fund for Rare Books.

Zinn, Joh. Gottfried. Descriptio anatomica ocvli hvmani iconibvs illvstrata. Gottingae, Vandenhoeck, 1755. The property of Benjamin Smith Barton and Addinell Hewson; purchased for Dr. Wistar by H. L. Hodge, 1816.

Presented by S. Lewis Ziegler, M.D.

Manuscripts

de Gordon, Bernard. Lilium medicinae. [Illuminated manuscript transcribed by John Kokkys, or Cokkes, of Oxford.] 15th Century stamped brown leather binding. [Oxford, 1348.]

Bequeathed by Sir William Osler, Bart.

de Wecker, Louis. l'Iridotomie. Translated by S. L. Ziegler. [Phila., 1873.] [Extr.—Annales d'oculistique. 1873.]

Presented by S. Lewis Ziegler, M.D.

de Wecker, Louis, and Landolt, E. Iridotomy. Translated by S. L. Ziegler. [Phila., 1890.] [Extr.—Traité complét d'ophthalmologie, 1890.]

Presented by S. Lewis Ziegler, M.D.

Other Interesting Additions

A Badge of the International Congress of Surgery, Warsaw, 1929; Medal given to the Officers and Soldiers in the World War, 1916, by the Town of Verdun; also a Medal of Base Hospital No. 10, U. S. Army, World War, 1917.

Presented by Astley P. C. Ashhurst, M.D.

Austrian Coin commemorating the Centenary of Theodor Billroth, 1829–1929.

Presented by Oscar V. Batson, M.D.

Four Cuts: 1 of Pathological Society of Philadelphia, 2 of College of Physicians of Philadelphia Medal and 1 of the College of Physicians Building.

Presented by William Zentmayer, M.D.

We have also received during the past year a number of interesting and more or less valuable autograph letters.

Use of the Photostat: During the past year there have been furnished to Fellows of the College 393 prints, and to other than Fellows, on application, 146 prints. These outside applications include requests from Boston, Baltimore, Carthage, Ill., Jeannette, La., Kansas City, Mo., Philadelphia, San Francisco, Calif., Schenectady, N. Y., and Washington, D. C.

The work for the Library has been continued as heretofore according to the instructions of the Library Committee. 3478 large and small prints have been made; 11 volumes of incunabula completed, as well as various portraits and manuscripts.

Up to the present time there have been made photostat reproductions of 273 incunabula.

There have been some increase to the principal of the Library Endowment Funds through change in investment during the year, as follows:

Louis A. Duhring Library Fund	$18,673.17
Augustus A. Eshner Library Fund (new)	5,000.00
Weir Mitchell Library Fund	115.00
Philadelphia Medical Society Fund	57.50
George B. Wood Fund	107.50
	$23,953.17

A complete list of all the Funds and the expenditures for the year is given in a previous part of this report. All additional expenses, salaries, binding, etc., have to be governed according to the funds appropriated by the College to the Library Committee annually.

There was an exhibition of the works written or edited by the Charter Members of the Philadelphia Academy of Surgery at their Semi-Centennial Meeting, April 22, 1929.

An account of stock has been taken and any displacement found arranged in their proper order; no report has been made of any books missing from the shelves.

There have been two changes in the Library force during the past year.

Library Committee,

George W. Norris, M.D.,
Chairman.

INDEX.

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